ANTENNA DEHYDRATORS FOR SC SERIES

Refer to article under SA series about antenna dehydrators.

TECHNICIAN'S CHECKOFF LIST WEEKLY CHECKOFF

Transmitter

a. Clean out accumulated dust and chips with dry air hose or bellows.
b. Tighten all side shields.
c. Check interlocks.

Receiver-Indicator

a. Check receiver interlock.
b. Check operation of all panel controls.
c. Check operation of heaters.
d. Clean out accumulated dust and chips.

Control Unit

a. Clean out accumulated dust and chips.
b. Check shaft connection and contact brush on Variac T-101.
c. Check all panel controls.
d. Control system should be operated a minimum of two hours per week, with one continuous period of at least a half hour long.

Duplexer

a. Tungsten points should be turned so that gap closes; then opened one-fourth turn.

Master PPI

a. Clean out accumulated dust and chips.
b. Check operation of heaters.
c. Clean contact rings and brushes.
d. Check operation of all panel controls.
e. Tighten all shields.
f. Check operation of all interlocks.
g. Check relay (if sector sweep is used).

Antenna and Pedestal

a. Check interlock operation.
b. Check operation of stowing brake (SK Series).
c. Check operation of heaters.

Dehydrator and Coaxial Line

a. Check cycles of operation of dehydrator.

MONTHLY CHECKOFF

Transmitter

a. Check contacts of relays K-301 and K-302 for pitting and carbon; clean with fine emery cloth.
b. Check sliding contacts on coupling system and output matching stub link.
c. Check control bearings.

Receiver-Indicator

a. Check lubrication of range mechanism.
b. Check coax and cables coming into unit.

Control Unit

a. Check gears between B-101 and B-104.
b. Check brushes and commutator of B-101.

Duplexer

a. Clean out accumulated dust and chips. Remove capacitors and spark gaps and clean with carbon tetrachloride and fine emery cloth if necessary.

Master PPI

a. Bearings, movable parts, and gear train lubrication.

Antenna and Pedestal

a. Check oil levels.
b. Check lubrication of rotary joint.
c. Check for oil leaks.
d. Check drive motor brushes.
e. Check array for corrosion and peeling off of paint.
f. Check array for air leaks.

Amplidyne

a. Check brushes (replace if less than three-eighths inch).
b. Clean out accumulated dust and chips.

Motor Generator

a. Check brushes (replace if less than three-eighths of an inch).
b. Clean out accumulated dust and chips.

Dehydrator and Coaxial Line

a. Check lubrication of bearings on motor.
b. Check airtightness of line.

QUARTERLY CHECKOFF

Amplidyne

a. Check lubrication of bearings.

SEMIANNUAL CHECKOFF

Control Unit

a. Check ball bearings on B-101.

Motor Generator

a. Check lubrication of bearings.

ANNUAL CHECKOFF

Master PPI

a. Check slewing motor ball bearings.

Antenna and Pedestal

a. Check drive motor bearings lubrication.

LUBRICATION CHART (SC, SC–1)

Proper maintenance requires periodic lubrication of the various components. This chart is intended to reference the units involved, time serviced, and to give the Navy type number if available. Reference must also be made to the instruction book for location of lubrication points and the quantity of lubricant required.

Equipment			Service					Lubrication data						
Unit involved	Name of component	Circuit symbol	Hours	Daily	Weekly	Monthly	Annual	Oil	Grease	Instruction book type	Commercial type	Navy type	Nearest Navy equivalent	Comments
Transmitter	Coupling system and output matching stub sliding contacts.		As required							Aquadag or Tetradag				See Note 1.
	Bearings of panel controls						Q	X		Light oil, Navy symbol 5065.	SAE 30–40		3065, 9250, 2250	Apply sparingly.
Control unit	Bearings of panel controls						Q	X		Light oil, Navy symbol 5065.	SAE 30–40		3065, 9250, 2250	Apply sparingly.
	Gears between slewing motor, B–101, and synchro, B–104.						Q		X	Navy Spec. 14L3 (INT) Grade B grease.	Ball and roller bearing lubricant Grade 2.	14–L–3 Grade II.		Recoat gears—see Note 1.
	Gears between synchro, B–102, and indicator bug.									Do not lubricate.				
	Slewing motor, B–101, ball bearings.						S		X	Navy Spec. 14L3 (INT) Grade B grease.	Ball and roller bearing lubricant Grade 2.	14–L–3 Grade II.		Repack—see Note 1.
	Step-by-step motor, B–105						Q	X		Light machine oil	SAE 20–30		2190, 2190–T, 9250	Put a drop of oil on felt pads near the bearings.
Receiver-indicator	Range mechanism						S	X		Light machine oil not heavier than SAE 40.	SAE 20–30		2190, 2190–T, 9250	Two drops on gear and on rotating stops.
Pedestal	Top housing						X	X		Univis No. 48			O. S. 1113	Fill to proper level. Check level quarterly.
	Bottom housing						X	X		Univis No. 48			O. S. 1113	Fill to proper level. Check level quarterly.
	Lower motor bearing						X		X	Beacon M–285 grease (Spec. ANG–3).	M–285	AN–G–3	O. S. 1350	Repack at each major overhaul.
	Top motor bearing									Lubricated by oil in bottom housing.				
	Rotary joint						Q		X	Beacon M–285 grease (Spec. ANG–3).	M–285	AN–G–3	O. S. 1350	Not more than ¼ ounce.
	Gears in synchro gear train						Q	X		Univis No. 48			O. S. 1113	
Amplidyne	Bearings						X		X	Navy Spec. 14L3 (INT) Grade B grease.	Ball and roller bearing lubricant Grade 2.	14–L–3 Grade II.		See Note 1 and Note 2.
Motor-alternator	Bearings						X		X	Navy Spec. 14L3 (INT) Grade B grease.	Ball and roller bearing lubricant Grade 2.	14–L–3		See Note 3.

NOTE 1.—Clean with cleaning solvent as recommended in General Lubrication Notes in Instruction Book.

NOTE 2.—Each cup should be given 1 turn every 3 months. Repack annually.
Q = Quarterly.
S = Semiannually.

NOTE 3.—Add grease every 6 months. Grease should be added through the grease fittings until new grease shows at relief holes. Then run motor-alternator for ½ hour with plugs removed to remove excess grease. Repack annually.

LUBRICATION CHART (SC–2)

Proper maintenance requires periodic lubrication of the various components. This chart is intended to reference the units involved, time serviced, and to give the Navy type number if available. Reference must also be made to the instruction book for location of lubrication points and the quantity of lubricant required.

Equipment			Service					Lubrication data						
Unit involved	Name of component	Circuit symbol	Hours	Daily	Weekly	Monthly	Annual	Oil	Grease	Instruction book type	Commercial type	Navy type	Nearest Navy equivalent	Comments
Transmitter	Coupling system and output matching stub sliding contacts.		As required							Aquadag or Tetradag				See Note 1.
	Bearings of panel controls						Q	X		Light oil, Navy symbol 5065.	SAE 30–40		3065, 9250, 2250	Apply sparingly.
Control unit	Bearings of panel controls						Q	X		Light oil, Navy symbol 5065.	SAE 30–40		3065, 9250, 2250	Apply sparingly.
	Gears between slewing motor, B–101, and synchro, B–104.						Q		X	Navy Spec. 14L3 (INT) Grade B grease.	Ball and roller bearing lubricant Grade 2.	14–L–3 Grade II.		Recoat gears—see Note 1.
	Gears between synchro, B–102, and indicator bug.									Do not lubricate.				
	Slewing motor, B–101, ball bearings.						S		X	Navy Spec. 14L3 (INT) Grade B grease.	Ball and roller bearing lubricant Grade 2.	14–L–3 Grade II.		Repack—see Note 3.
Receiver-indicator	Range mechanism						S	X		Light machine oil not heavier than SAE 40.	SAE 20–30		2190, 2190–T, 9250	Two drops on gears and on rotating stops.
PPI	Bearings and movable parts requiring oil.						Q	X		Light oil, Navy symbol 5065.	SAE 30–40		3065, 9250, 2250	
	Slewing motor ball bearings	B2200					X		X	Navy Spec. 14L3 (INT) Grade B grease.	Ball and roller bearing lubricant Grade 2.	14–L–3 Grade II.		Repack—see Note 1.
	Gear train						Q		X	Navy Spec. 14L3 (INT) Grade B grease.	Ball and roller bearing lubricant Grade 2.	14–L–3 Grade II.		Coat gears.
Pedestal	Top housing						X	X		Univis No. 48			O. S. 1113	Fill to proper level. Check level quarterly.
	Bottom housing						X	X		Univis No. 48			O. S. 1113	Fill to proper level. Check level quarterly.
	Lower motor bearing						X		X	Beacon M–285 grease (Spec. ANG–3).	M–285	AN–G–3	O. S. 1350	Repack at each major overhaul.
	Top motor bearing									Lubricate by oil in bottom housing.				
	Rotary joint						Q		X	Beacon M–285 grease (Spec. ANG–3).	M–285	AN–G–3	O. S. 1350	Not more than ½ ounce.
	Gears in synchro gear train						Q	X		Univis No. 48			O. S. 1113	
Amplidyne	Bearings						X		X	Beacon M–285 grease (Spec. ANG–3).	M–285	AN–G–3	O. S. 1350	See Note 1 and Note 2.
Motor-alternator	Bearings						X		X	Navy Spec. 14L3 (INT) Grade B grease.	Ball and roller bearing lubricant Grade 2.	14–L–3 Grade II.		See Note 3.

NOTE 1.—Clean with cleaning solvent as recommended in General Lubrication Notes in Instruction Book.

NOTE 2.—Each cup should be given 1 turn every 3 months. Repack annually.
Q = Quarterly.

NOTE 3.—Add grease every six months. Grease should be added through the grease fittings until new grease shows at relief holes. Then run motor-alternator for ½ hour with plugs removed to remove excess grease. Repack annually.
S = Semiannually.

LUBRICATION CHART (SC–3, SC–4, SC–5)

Proper maintenance requires periodic lubrication of the various components. This chart is intended to reference the units involved, time serviced, and to give the Navy type number if available. Reference must also be made to the instruction book for location of lubrication points and the quantity of lubricant required.

Equipment			Service					Lubrication data						
Unit involved	Name of component	Circuit symbol	Hours	Daily	Weekly	Monthly	Annual	Oil	Grease	Instruction book type	Commercial type	Navy type	Nearest Navy equivalent	Comments
Transmitter	Coupling system and output matching stub sliding contacts.		As required							Aquadag or Tetradag				See Note 1.
	Bearings of panel controls						Q	X		Light oil, Navy symbol 5065.	SAE 30–40		3065, 9250, 2250	Apply sparingly.
Control unit	Bearings of panel controls						Q	X		Light oil, Navy symbol 5065.	SAE 30–40		3065, 9250, 2250	
	Gears between slewing motor, B–101 and synchro, B–104.						Q		X	Navy Spec. 14L3 (INT) Grade B grease.	Ball and roller bearing lubricant Grade 2.	14–L–3 Grade II.		Recoat gears—see Note 1.
	Gears between synchro, B–102 and indicator bug.									Do not lubricate.				
	Slewing Motor, B–101, ball bearings.						S		X	Navy Spec. 14L3 (INT) Grade B grease.	Ball and roller bearing lubricant Grade 2.	14–L–3 Grade II.		Repack—see Note 1.
Receiver-indicator	Range mechanism						X	X		Light machine oil not heavier than SAE 40.	SAE 20–30		2190, 2190–T, 9250.	Two drops on gears and on rotating stops.
PPI	Bearings and movable parts requiring oil.						Q	X		Light oil, Navy symbol 5065.	SAE 30–40		3065, 9250, 2250	
	Slewing motor ball bearings	B–2200					X		X	Navy Spec. 14L3 (INT) Grade B grease.	Ball and roller bearing lubricant Grade 2.	14–L–3 Grade II.		Repack—see Note 1.
	Gear train						Q	X		Navy Spec. 14L3 (INT) Grade B grease.	Ball and roller bearing lubricant Grade 2.	14–L–3 Grade II.		Coat gears.
Pedestal	Gear case						Q	X		SAE 30 with rust inhibitor.			O. S. 1363, 2190–T, 9250.	See Note 2.
	Bearings on driving motor						X		X	Navy Spec. 14L3–C (INT) grease.	Ball and roller bearing lubricant Grade 4.	14–L–3 Grade II.		Repack chamber ½ full—see Note 1.
	Rotary joint on top of pedestal.						Q		X	Beacon M–285 grease (Spec. ANG–3).	M–285	AN–G–3	O. S. 1350	Not more than ¼ ounce.
Amplidyne	Bearings						X		X	Beacon M–285 grease (Spec. ANG–3).	M–285	AN–G–3	O. S. 1350	See Note 1 and Note 3.
Motor-alternator	Bearings						X		X	Navy Spec. 14L3 (INT) Grade B grease.	Ball and roller bearing lubricant Grade 2.	14–L–3 Grade II.		See Note 4.
Automatic dehydrating system.	Electric motor sleeve type bearings.						Q	X		Light oil, Navy symbol 5065.	SAE 30–40		3065, 9250, 2250	Overoiling should be avoided.

NOTE 1.—Clean with cleaning solvent as recommended in General Lubrication Notes in Instruction Book.

NOTE 2.—Maintain at proper level. Drain and change oil every 3 months.

NOTE 3.—Repack annually. Repack chamber ½ full.

Q=Quarterly.

NOTE 4.—Add grease every 6 months. Grease should be added through the grease fittings until new grease shows at relief holes. Then run motor-alternator for ½ hour with plugs removed to remove excess grease. Repack annually.

S=Semiannually.

LUBRICATION CHART (SK, SK-2, SK-3)

Proper maintenance requires periodic lubrication of the various components. This chart is intended to reference the units involved, time serviced, and to give the Navy type number if available. Reference must also be made to the instruction book for location of lubrication points and the quantity of lubricant required.

Equipment			Service					Lubrication data							
Unit involved	Name of component	Circuit symbol	Hours	Daily	Weekly	Monthly	Annual	Oil	Grease	Instruction book type	Commercial type	Navy type	Nearest Navy equivalent	Comments
Transmitter	Coupling system and output matching stub sliding contacts.		As required					---	---	Aquadag or Tetradag				See Note No. 1.
	Bearings of panel controls						Q	X	---	Light oil, Navy symbol 5065.	SAE 30-40		3065, 9250, 2250	Apply sparingly.
Control unit	Bearings of panel controls						Q	X	---	Light oil, Navy symbol 5065.	SAE 30-40		3065, 9250, 2250	Apply sparingly.
	Gears between slewing motor, B-101, and synchro, B-104.						Q	---	X	Navy Spec. 14L3 (INT) Grade B grease.	Ball and roller bearing lubricant Grade 2.	14-L-3 Grade II.		Recoat gears—see Note No. 1.
	Gears between synchro, B-102, and indicator bug.						---	---	---	Do not lubricate.				
	Slewing motor, B-101 ball bearings.						S	---	X	Navy Spec. 14L3 (INT) Grade B grease.	Ball and roller bearing lubricant Grade 2.	14-L-3 Grade II.		Repack—see Note No. 1.
Receiver-indicator	Range mechanism						S	X	---	Light machine oil not heavier than SAE-40.	SAE 20-30		2190, 2190-T, 9250.	Two drops on gears and on rotating stops.
PPI	Bearings and movable parts requiring oil.						Q	---	X	Light oil, Navy symbol 5065.	SAE 30-40		3065, 9250, 2250	
	Slewing motor ball bearings	P 400					X	---	X	Navy Spec. 14L3 (INT) Grade B grease.	Ball and roller bearing lubricant Grade 2.	14-L-3 Grade II.		See Note No. 1.
	Gear train						Q	X	---	Navy Spec. 14L3 (INT) Grade B grease.	Ball and roller bearing lubricant Grade 2.	14-L-3 Grade II.		Coat gears.
Pedestal	Driving motor gear case						Q	---	X	NT 9250		9250		See Note No. 2.
	Motor pinion and gear, synchro gears, and brake gear train, shafts and bearings.						Q	---	X	Beacon M-285 grease (Spec. ANG-3).	M-285	AN-G-3	O. S. 1350	Quantity as required.
	Lower bearing on driving motor.						X	---	X	Beacon M-285 grease (Spec. ANG-3).	M-285	AN-G-3	O. S. 1350	Repack chamber ½ full—see Note No. 1.
	Upper bearing on driving motor.						---	---	---	Lubricated by oil in gear housing.				
	Rotary joint on top of pedestal						Q	---	X	Beacon M-285 grease (Spec. ANG-3).	M-285	AN-G-3	O. S. 1350	Not more than ¼ ounce.
Amplidyne	Bearings						X	---	X	Beacon M-285 grease (Spec. ANG-3).	M-285	AN-G-3	O. S. 1350	See Note No. 1 and Note No. 3.
Motor-alternator	Bearings						X	---	X	Navy Spec. 14L3 (INT) Grade B grease.	Ball and roller bearing lubricant Grade 2.	14-L-3 Grade II.		See Note No. 4.
Automatic dehydrating system.	Electric motor sleeve type bearings.						Q	X	---	Light oil, Navy symbol 5065.	SAE 30-40		3065, 9250, 2250	Overoiling should be avoided.

NOTE 1.—Clean with cleaning solvent as recommended in General Lubrication Notes in Instruction Book.

NOTE 2.—Maintain at proper level as indicated by bayonet-type gauge. Drain and change oil every 3 months.

Q=Quarterly. S=Semiannually.

NOTE 3.—Each cup should be given one turn every 3 months. Repack annually.

NOTE 4.—Add grease every 6 months. Grease should be added through the grease fittings until new grease shows at relief holes. Then run motor alternator for ½ hour with plugs removed to remove excess grease. Repack annually.

TUNING SC/SK EQUIPMENT WITH OAA-2

Numerous reports have been received from the field complaining of poor SC/SK performance when the equipment was tuned with OAA-2. In many cases this has been due to inadequate information on the limitations of the OAA-2 when used to tune the transmitter to maximum power output.

Since the OAA-2 sensitivity varies with the frequency and favors certain frequencies within its range, the maximum reading on the OAA-2 meter does not necessarily indicate the absolute maximum power output of transmitter, e.g., the maximum response of the OAA-2 may not be at the frequency of the maximum power output of transmitter.

The OAA-2 may be used for the following purposes:

a. To measure the frequency of the transmitter.

b. To tune the transmitter for a maximum power output at a particular frequency.

c. To tune the receiving system to optimum performance.

Installation and Operation Notes on OAA-2:

For the SC, SC-1, and SC-2, the OAA-2 test antenna should be about 10 feet in front of and 5 feet below the centerpoint of the lowermost row of elements of the radar antenna. For the SK, the test antenna should be about 10 feet in front of and 2 feet below the centerpoint of the lowermost row of elements of the radar antenna. The test antenna should be parallel to the radar antenna elements. The dimensions given above are subject to modification by convenience of mounting and by scale reading at optimum tuning. About three-fourths scale on the "high" scale is the most desirable reading.

The best location of the OAA-2 meter is adjacent to the transmitter. The OAA-2 must be attached by coaxial cable to its pickup antenna.

When using the OAA-2, the radar antenna should be trained so that the radar antenna elements are parallel to the OAA-2 test antenna. The radar equipment should be allowed to warm up at least 15 minutes before tuning is attempted with the OAA-2.

The use of the OAA-2 to tune the receiving system is not practical if there are strong adjacent targets. In this case the receiving system can best be tuned to peak performance on these targets. However, the OAA-2 is very useful in tuning and checking the receiving system when no targets are available.

The following procedure is recommended to tune the transmitter to maximum power output at a particular frequency with the OAA-2:

a. Bring transmitter plate voltage up to normal value. (It may be necessary to change the setting of the OSC TUNING and OUTPUT MATCHING controls to avoid corona.)

b. Turn on the OAA-2 and adjust the micrometer to a desired frequency by means of the calibration chart on the side of the meter.

c. Set OUTPUT COUPLING control at midscale.

d. Turn the OSC TUNING control slowly for maximum deflection of the OAA-2 meter.

e. If meter does not deflect in step (d) turn OUTPUT MATCHING control in steps of 20 divisions. After each step tune OSC TUNING control slowly until meter deflects.

f. Tune OSC TUNING, OUTPUT MATCHING and OUTPUT COUPLING controls for maximum deflection of OAA-2 meter. These three controls require several tunings, since they interact. Do not tune the OUTPUT MATCHING control close to the grid current minimum.

g. If the above procedure has been followed correctly, the transmitter should be tuned to maximum power at the frequency set on the OAA-2.

h. This procedure should be followed for a number of frequencies in the band and all dial readings recorded for each frequency. Thus, the system can be set up at each frequency and the performance at each frequency can be compared on actual targets. The frequency of optimum performance can now be determined.

The SC does not have an OUTPUT COUPLING control. When tuning the SC, step c is eliminated and mention of OUTPUT COUPLING control should be disregarded.

The following procedure is recommended to tune the receiving system to optimum performance with the OAA-2:

a. Tune the transmitter to maximum power output at a particular frequency as outlined in paragraphs a through h above.

b. Check the spark gaps in the duplexer. They should be arcing with a steady sound but not sputtering. Adjust if necessary. (Check to see there is no arcing across the capacitor plates in the duplexer.)

c. Knowing the frequency of the transmitter from b on page 2-8, set the receiver OSC and R-F controls to the approximate positions indicated by the calibration chart which is located just behind the front panel of the receiver.

d. Switch indicator to first range, turn gain control to one-sisteenth inch grass on "A" scope.

e. Rock OSC and R-F controls either side of setting obtained from calibration chart. The OAA-2 ringing time (large, wide echo near left end of trace) should appear. If ringing time appears, proceed to step g.

f. If OAA-2 ringing time does not appear proceed as follows:

(1) Turn GAIN control CCW until transmitter pulse (narrow saturation echo at extreme left of trace) is about three-quarter inch above trace.

(2) Tune OSC control for maximum transmitter pulse height. If two or more pulses appear, use highest. If pulse reaches saturation, turn GAIN control counter clockwise.

(3) Repeat procedure with R-F and ANT controls and all controls on preamplifier if used.

(4) Turn GAIN control to one-sixteenth inch grass on "A" scope. OAA-2 ringing time should appear.

g. Turn range step control until step is one-quarter inch to the right of OAA-2 ringing time. Tune the following controls for maximum range of OAA-2 ringing time (not maximum height): OSC, R-F, ANT, C-1003 (capacitor in duplexer receiver tank), and all controls of preamplifier (if preamplifier is used).

h. Ordinarily, control C-1004 (capacitor in duplexer transmitter tank) will not affect the echoes. However, in

some equipments one point will be found where the signal amplitude varies greatly with the position of this control. Do not tune close to this point.

i. After all controls have been peaked up all controls with locks should be locked.

j. Record all dial readings, the maximum range of OAA-2 ringing time, and the antenna bearing.

k. Detune OAA-2 micrometer three full turns.

l. The above procedure can be followed for each frequency at which the maximum power output of the transmitter has been determined.

APPROVAL AND USE OF LUBRICATING OIL NAVY TYPE 9250

To reduce oil leakage to SC and SK type antennas, the Bureau approves the use of a heavier type lubricant (Navy type 9250 oil). Use this lubricant in pedestals of the SC, SC-1 and SC-2, and in the pedestal gear box of Radar Equipments SK and SK-2. At the first availability, drain, flush, and refill with the proper amount of Navy type 9250 oil. This oil should be replaced every 3 months thereafter.

Each instruction book should be corrected to include this data and the new type lubricant should be stenciled on the pedestal.

It is requested that this information be disseminated to all personnel assigned to the operation and maintenance of SC/SK type radar equipments.

RADAR ANTENNA HOIST

Trouble was experienced with the SC-type antenna and a hoist devised from a fish davit to lower the antenna to the deck. This hoist was suitably supported, bracketed and welded to the top of the lookout station on the forward king post, as shown in figures 1, 2, and 3.

PREVENTING DEMAGNETIZATION OF ANTENNA DRIVE MOTOR (B-503)

When an SK or SK-2 motor is run for test on a d-c line, it should be connected with the power to A_1 and S_2. A_2 should not be connected. Its end should be taped to prevent shorting. If the motor is tested in this manner, there is no danger of demagnetizing the permanent magnet. If A_2 is connected to either S_2 or A_1 and the motor is run for any length of time, it will become demagnetized.

WINDING COILS OF SOLENOID IN STOWING BRAKE (SK, SK-2, SK-3)

Wind top coil (G.E. No. 3240450) with 160 turns, glass insulation No. 16 B. & S., 0.76 foot mean length per turn. Turn length, 120 feet; d-c resistance, 0.5 ohm.

Wind bottom coil (G.E. No. 3240451) with 93 turns, glass insulation No. 14 B. & S., 0.76 foot mean length per turn. Total length 70 feet; d-c resistance 0.2 ohm.

Coils must be wound tight and compact so that there will be no bulge beyond the coil form, otherwise it will not fit into place.

Paint coils with glyptal or shellac.

After the rewound coils have been installed, the stowing brake should be adjusted. Detailed instructions for this are given in Field Change 18-SK.

SERVICING THE PEDESTAL CONTROL SYSTEM

This article covers the correction of troubles in amplidynes and drive motors, and includes servicing of demagnetized motors. It is divided into four parts:

a. Finding the source of trouble in a system.

b. Notes on pedestal motors.

c. Notes on amplidynes.

d. Suggested possibilities in an emergency.

Looking for Trouble: Nominal circuit values of normal current and voltage at various points in the antenna control system are given in the instruction books and on pages two to twenty. Under usual operating conditions, a deviation from these nominal values of at least 10 percent is not objectionable. Any values which are found to be off by a factor of, say, two-to-one, should immediately point out where the fault lies.

If the trouble includes oscillation, meter readings cannot be taken. If the oscillation cannot be removed by some reversal of lead connections, it can be eliminated by removing the control amplifier inputs. These are the error signal voltage from the 5CT synchro and the antihunt feedback from the pedestal drive motor. Connect a few volts a.c. from the synchro bus directly to the amplifier error signal input, terminals TB 12-7 and TB 12-8, at the control unit. Then check the units of the drive system to see that they are giving normal performance.

If a voltmeter and ammeter are not available, one can find out quite a bit by listening to the sound of the amplidyne. When the control system is operated, one can, after very little practice, distinguish differences in sound when the amplidyne is unloaded, when the output voltage builds up, and the groan when load current becomes excessive. It is better, of course, to check with meters.

The following list of symptoms may help in locating causes of trouble. More obvious causes of trouble, such as open connections, are not included.

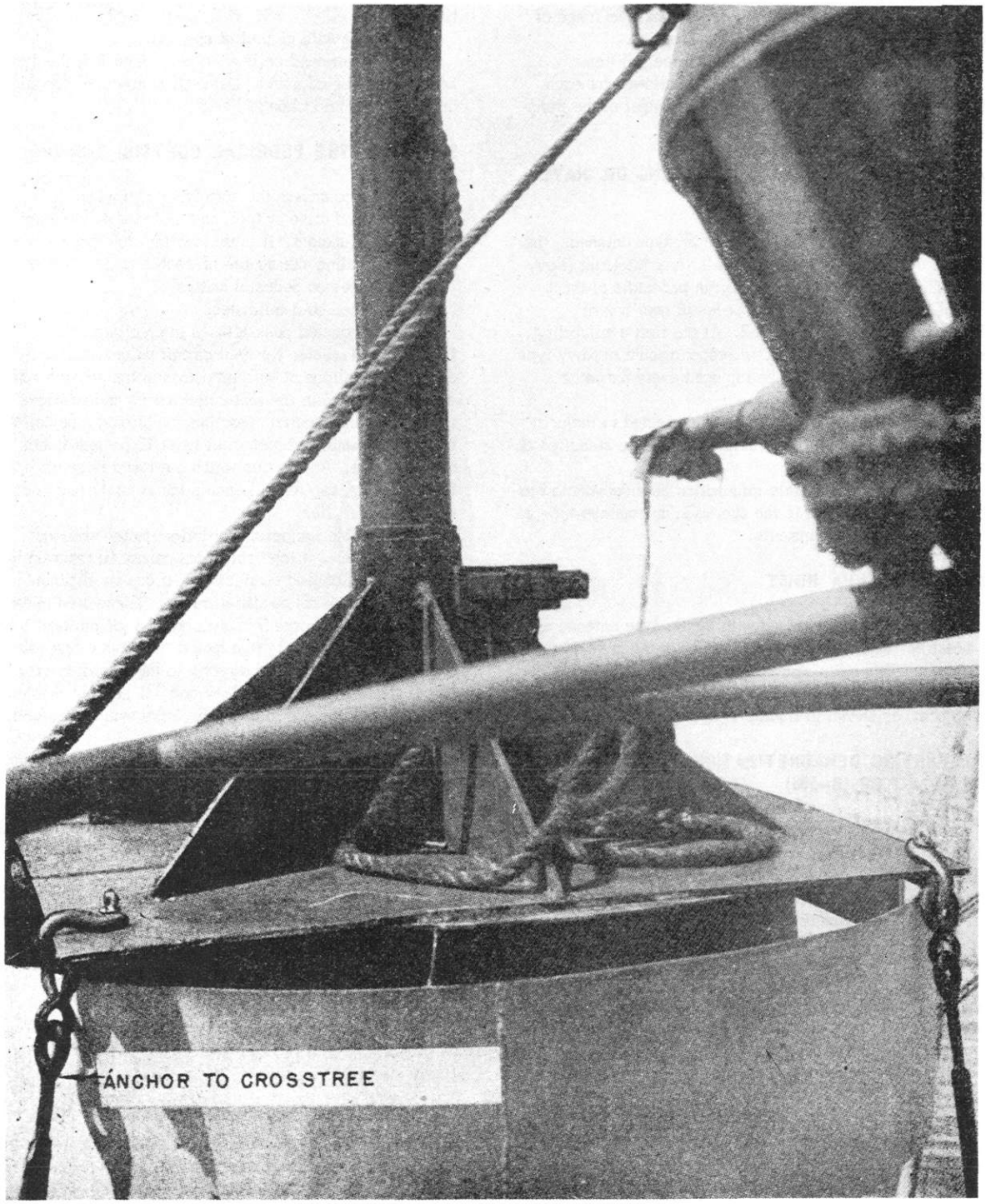


FIGURE 1.—U. S. S. *Cavalier* supporting base for davit fabricated and welded to lookout station.

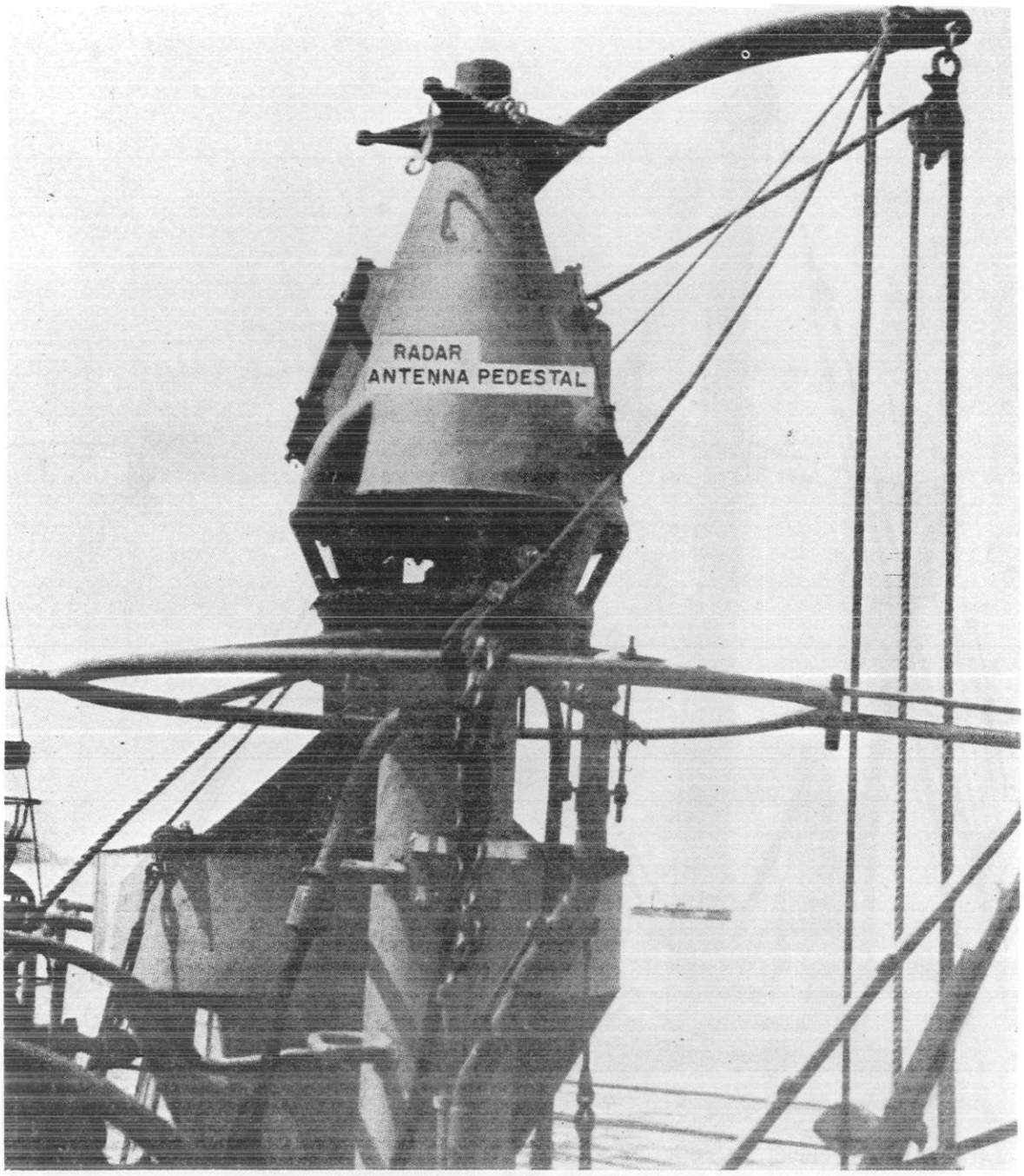


FIGURE 2.—U. S. S. *Cavalier* pedestal with antenna removed.

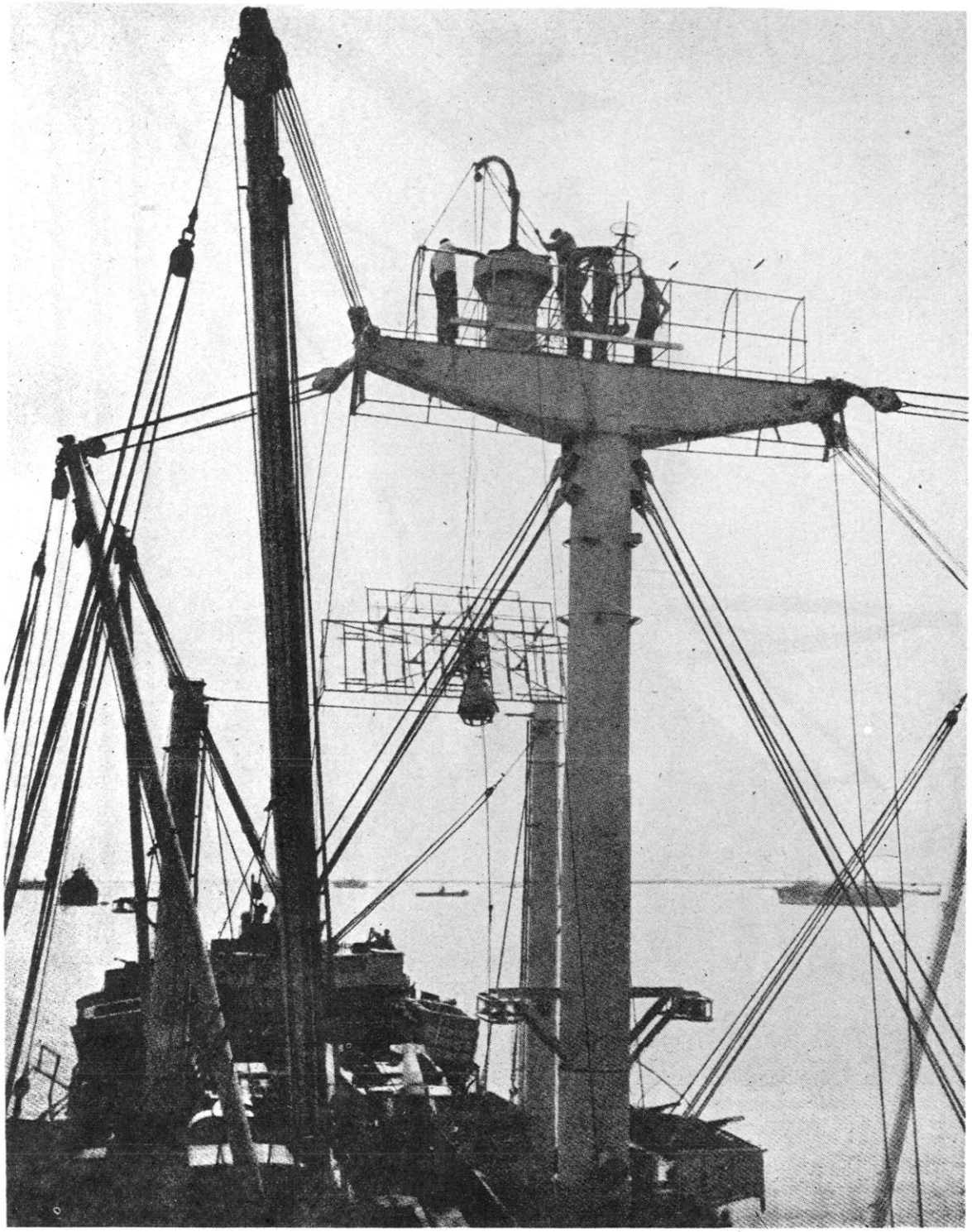


FIGURE 3.—U. S. S. *Cavalier* radar antenna and pedestal being hoisted.

Case "A." Pedestal motor voltage and current is normal, but the antenna falls out of step for 1 direction of rotation. The error signal voltage is high-10 volts or more-when the antenna is stationary. This may be due to a bad tube in the control amplifier. If not, look for a ground-its resistance anywhere from 0 to 50,000 ohms-in the amplifier or in the circuit from the amplidyne output to the pedestal drive motor. Such a leakage resistance indicates poor insulation which should be repaired or replaced. For relief from the symptoms of poor operation, disconnect the wire within the control amplifier which serves to ground the tube shells of the vacuum tubes V-151, V-152, and V-153. This will allow the antenna to train properly but will not replace the bad insulation. If the ground is due to low insulation resistance in the pedestal motor itself, clean the insulation as described in the section entitled "Motor Care."

CASE "B." If the antenna motor current is normal at creeping speed, but abruptly becomes very high and the antenna stops when the slewing motor speed is increased (for both directions of rotation), then probably there is arcing occurring somewhere in the amplidyne, in the cables from the amplidyne to the pedestal, or in the motor itself. This can be located by (1) disconnecting the pedestal motor leads, A_1, A_2, and S_2, from the cable and (2) disconnecting the cable from the amplidyne output leads, in each case testing to see whether the amplidyne still groans and slows down from overload when the amplidyne output voltage builds up. If the trouble is in the motor, look for oil on the commutator. If the arc is in the amplidyne, look for a loose lead rubbing on the commutator surface.

This cause of trouble is quite rare, and should not be confused with Case "A." When the antenna is stationary the error signal voltage is normal, 2 or 3 volts, and loss of control occurs for both directions of rotation, if the trouble is caused by arcing. These symptoms are not true of Case "A."

Case "C." The average motor current is normal, and the voltage is normal for the speed of rotation observed, but the motor current jumps erratically as the antenna rotates. Examine the error signal voltage with an oscilloscope or a high impedance, quick response voltmeter such as an analyzer. If the error signal voltage-terminals TB 12-7 and TB 12-8—is discontinuous and erratic, look for oil on the slip rings of the 5CT synchro in the pedestal.

Case "D." The amplidyne has zero output with full field excitation. (Make certain of excitation. Apply a few dry cells or a "C" battery directly to any two of the amplidyne field leads.) All amplidyne resistance values check O.K. (See p. 2-20.) Look for an open connection in the quadrature axis circuit. In the SC and SC-1 amplidyne, 5AM45DB5, the quadrature axis brushes—two opposite pairs—are shorted together by a single wire within the end shield. On the SC-2 amplidyne, 5AM73AB58, the quadrature axis brushes are connected by a series winding on the stator. Terminal clamps on the brush holders may have become corroded or loosened.

Case "E." The amplidyne output is low, causing the antenna to fall out of step at a moderate speed for either direction of rotation. If the amplidyne is left running more than a very few minutes, the motor end only overheats. Eventually the starting capacitor will fail. Check to see that the starting switch operates and that the amplidyne comes up to full speed. See that the starting capacitor is neither open or shorted. If it is open, the motor will not start and will overheat rapidly. The motor may start and accelerate to full speed if the capacitor is shorted. If starting is O.K., and both halves-motor and generator-of the amplidyne set become hot, look for symptoms of cases, "B," "C," "F," or "G."

Case "F." The pedestal motor voltage is high for the antenna speed observed and the current is also high, or the same symptoms are present as in case "C." If the error signal voltage, measured as in case "C," is continuous and reasonably smooth, look for binding in the pedestal gearing.

Case "G." The pedestal motor current is high at all speeds; motor voltage is normal or low. (See fig. 1.) The motor probably is partially demagnetized. If the antenna will not turn above creeping speed, and the motor current is very high, the motor is badly demagnetized or the pedestal gears are very tight. See the following section for remagnetizing a motor.

Motor Care: To remove a motor from its pedestal, first drain the oil from the lower chamber by means of the lower oil gage, then place a cloth around the top end of the motor to protect it from the one-half cup of oil which will pour out when the motor is released from the gear housing.

Remove the brushes before disassembling a motor.

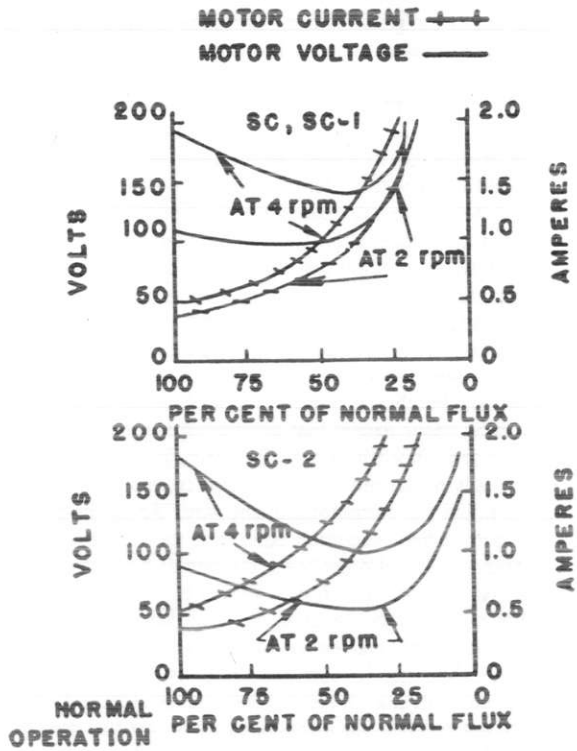


FIGURE 1.—Effect on pedestal drive motors of loss of magnetism.

Do not apply excessive force to the end shields. A rubber or leather mallet should be used gently. Never use a hammer. The biggest danger is that excessive force will deform the balls and races of the bearings.

Note the position of any spacers or springs under the bearings so that they may be returned to the same positions when reassembling.

REMAGNETIZING SC/SK SERIES PEDESTAL DRIVE MOTORS. Although a motor can be remagnetized while mounted in the pedestal, generally it is better to remove the motor to a more accessible location for inspection and remagnetization.

For a single isolated case, perhaps the simplest procedure is to use the motor armature winding itself to supply ampere turns for remagnetizing. To do this:

a. Remove the brushes.

b. Remove the commutator end shield, turn it 90° counterclockwise as viewed from the commutator end, and reassemble. If brush leads are short, turn the end shield 90° clockwise and apply opposite polarity in step (d).

c. Replace the brushes and block the rotor.

d. Apply between 250 and 300 volts d.c. with positive polarity on the A_1 lead and negative on the A_2 lead. Current required will be about 8 amperes for motor 5BBY-47AB3 and about 20 amperes for 5BBY47AB6, so that a fairly stiff source of power should be used. Leave the S_2 lead disconnected.[1]

e. Voltage should be applied for 1 second, two or three times.

f. As a check on polarity, when viewing the commutator end of the motor with the interpole to the left, the top magnets will be north and will attract the south pole of a normal compass. The motor will run counterclockwise, viewed from the commutator end, with A_1 positive.

g. Remove the brushes, change the end shield back to its original position and replace brushes.

The first time the rotor is removed from the field and immediately replaced, about 10 percent of the flux will be lost and the magnetism will be stable thereafter.

Slightly more effect can be obtained by applying the voltage directly to the commutator with test prods or other metal contacts to commulator bars 180° apart. Current should be sent through bars which are midway between the brushes when the motor is assembled in its regular operating condition. In other words, this is the same method as mentioned above except that the current is applied directly to the commutator bars rather than going through the brushes. When applying current to the commutator bars, be careful not to injure the commutator in any way. Apply the prods to some part of the commutator other than the surface on which the brushes ride. Do not break the circuit by removing a prod from the commutator, as this will burn a spot.

For more than two or three cases of damagnetized motors, it is more convenient to have a magnetizer constructed. The core for such a magnetizer can be made of almost any soft iron or steel. Cast iron or stainless steel should not be used since they saturate at low flux densities. Dimensions of the core are shown in figure 2.

The two slots in the core are to be lined with insulating paper or cloth and wound with the coil. The coil sides should not project above the maximum diameter of the core (3.26 inches). The coil can be wound for whatever voltage is available. For the chosen voltage, the coil wire size

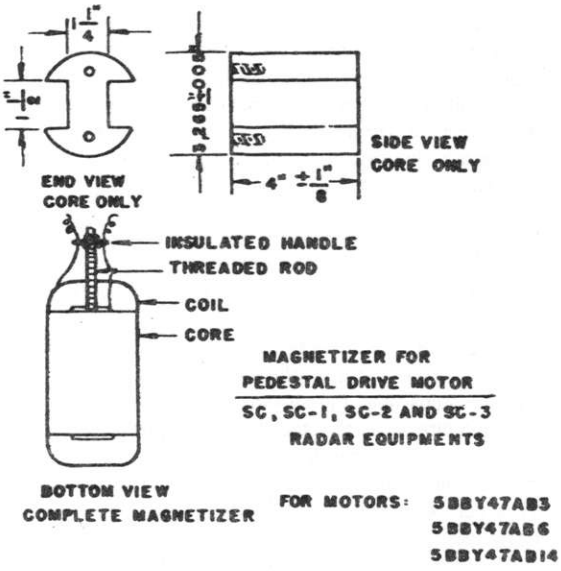


FIGURE 2.—Magnetizer for pedestal drive motor.

should be selected to produce at least 5,000 and preferably 10,000 ampere turns. No. 19 wire should be approximately correct for 110-volt use if the coil is layer wound. No. 10 wire will be correct for approximately 20 volts. A sample magnetizer random wound with No. 18 double cotton wire worked very well on 40 volts.

Whatever the voltage, the coil will require approximately 2 kw. in the pulses during which it is energized. Possible sources of voltage are a 220-volt line, a 110-volt line, a d-c arc welder, storage batteries, a meter magnetizer, etc. A capacitor discharge through the magnetizer coil is undesirable, since it will probably be oscillatory, producing a net demagnetizing effect. If the coil were continuously connected to the voltage, its temperature rise would be damaging. This is not important since the coil is energized for such short periods of time.

To remagnetize a motor with this magnetizer:

a. Remove the brushes and hand wheel from the commutator end shaft extension.

b. Mark the position of the opposite end shield (pully or gear end) with respect to the stator.

c. Remove the bolts which hold the pulley end shield to the stator frame and remove the rotor and end shield as a unit from the stator. Do not use a hammer. Make certain that no dirt or magnetic particles get into either the armature or the stator.

d. After removing all magnetic particles and dirt from the magnetizer, carefully place it within the stator. Each pole of the magnetizer covers three pole pieces of the motor which constitute one pole.

e. Apply power for 1 second, two or three times. Break the circuit with a switch capable of interrupting such an inductive load. For proper polarity, when viewing the stator from the pully end with the commutating pole at the right, the top magnets are north and will attract the south end of a normal compass. To produce flux in this direction, current should flow around in the direction of one's fingers when the thumb of the right hand is pointed in the direction of flux (downward).

f. Pull out the magnetizer and replace the rotor and end shield. Turn the shaft by hand to see that the bearings are free and that there is no dirt in the air gap.

g. When reassembled, check the motor magnetism by applying 250 volts d.c. to the A_1 and S_2 leads (try both polarities) and check the no load motor speed with a strobotac or a hand tachometer. Speed of the motor should be between 1,500 to 1,700 r.p.m. for the SC and SC-1 motor, 5BBY47AB3, and between 2,700 and 3,000 r.p.m. for the SC-2 motor, 5BBY47AB6.

If work is required on any part of the motor, such as turning the commutator, remagnetizing should not be done until after all other work is finished.

Do not remove the Alnico magnets from the motor. Loosening them will destroy the alignment of the pole faces.

Changing the direction of flux in the motor will not change the operation of the control system. It will mean that the hand crank dial in the control unit will read one-half revolution (5°) different from its former reading for a given antenna position. This can be corrected by rotating the 5CT synchro in the pedestal 180° or by reversing the 5CT rotor leads, but not by reversing the pedestal motor leads.

If the armature must be removed from the field of the motor for more than 5 minutes, a keeper should be placed within the stator. The keeper should be a cylindrical piece of iron at least as long as the pole pieces. It should be approximately of the same diameter as the armature and may be hollow, such as a piece of pipe, provided the wall thickness is at least three-sixteenths inch. In inserting or removing the armature or keeper, care should be taken to prevent damage to the windings.

To blow dirt out of the machine, use a blower or a bellows. The ordinary air hose blows air, water, and scale, instead of air alone.

Before reassembling the motor, examine the commutator and check the windings for insulation and continuity. If the commutator is rough, pitted, or out of round, it should be turned and polished.

With an ohmmeter, check at the commutator from bar to bar for open coils in the armature. A "growler" will check shorted coils but not open coils. A motor with an open coil may operate for a while, but it will require at least twice normal current and will arc severely at the commutator.

Leakage resistance of less than one-fourth megohm from the windings to the frame indicates that the insulation is damp or contains surface dirt.

If the insulation of the motor is oily or dirty, wipe with a clean cloth soaked in petroleum spirits (petroleum ether), naphtha, or carbon tetrachloride. Carbon tetrachloride is somewhat undesirable because it may cause corrosion of the exposed metal surfaces. Leaded gasoline should not be used. Benzine, toluene, or other aromatic (coal tar) solvents are undesirable because they soften the insulation varnish. Remove any excess solvent with a clean, dry cloth. The motor parts and the solvent should not be warmer than room temperature. All the usual safety precautions should be taken when dealing with a flammable liquid.

It would be well to bake the motor parts at a temperature below 110° C. for several hours in order to dry out the insulation. Leakage resistance will decrease as the winding temperature rises, but the resistance will increase as the winding dries out and as the temperature decreases.

If the windings have been damaged by overheating, the insulation resistance will be high and the only way to determine the condition of the insulation, without destroying it, is by a surface inspection by someone skilled in such matters.

If the bearings are to be used again, clean them with petroleum spirits or naphtha, and apply new grease. Add new grease immediately after cleaning so that the bearings will not rust. Carbon tetrachloride, should not be used for cleaning bearings. For general operating service, where both extremes of temperature may be encountered, use a stiff grease conforming to Navy Grade 14L3-C. The reservoir adjacent to the bearing should be only one-half filled with grease. Excess grease causes churning and may work out on to the commutator.

If the motor oil seal leaks, it should be replaced with a new one, glyptalled in place to prevent oil leakage over the outside of the seal. To avoid future oil leakage at the seal, the best results are obtained by running the motor at one-half speed for a few hours with the oil seal dry, to allow the seal to wear in a surface on the steel shaft. The motor should be run in both directions.

Motor and amplidyne repairs should be done by someone who has had enough experience to realize the value of carefulness and cleanliness.

AMPLIDYNE CARE

Amplidynes as used on SC series radar equipments consist of an amplidyne generator and a single phase power power motor mounted on a common shaft. On both sizes of amplidyne, there is a fan; and, on the SC-2 only, a two-pole Alnico magnet mounted on a shaft between motor and generator. The Alnico magnet's purpose is to apply pulses of current to the demagnetizing winding in order to reduce residual magnetism in the generator laminations.

Brushes should be inspected every 2 months, or oftener if they appear to be wearing rapidly. After inspection, each brush should be replaced in the properly numbered slot and with the same side up as before. (Number carved in brush should face the corresponding number stamped on the end shield.) If the amplidyne has been mounted so that some of its brushes are inaccessible, it should be relocated so that brushes will be accessible for normal servicing.

Whenever the brushes are checked, the commutator should be examined with a flashlight by removing the cover

plate at the amplidyne end of the machine. A commutator in good condition should be smooth and have a light chocolate brown color. If it is rough, pitted or out of round, it should be turned on a lathe and polished.

Before disassembling an amplidyne, remove the brushes and also mark the position of the amplidyne end shield so that it may be easily realigned with the stator at reassembly. Note the position of any spacers and springs in the bearing housings.

Due to the construction of the centrifugal starting switch mechanism, the motor end shield cannot be completely removed from the armature shaft until the texolite contact support plate is unscrewed from the motor end shield. The screws should be released to avoid breaking the textolite. Take care to notice the position of the spaces between textolite and end shield so that they may be replaced in the same order at reassembly. Otherwise the centrifugal switch may not operate on starting, causing the electrolytic starting capacitor to burn out. If possible, do not move any parts on the rotor shaft, as doing so may destroy the machine's balance. If the rotor must remain out of the stator for several days, a keeper of sheet iron should be bent to fit the pole tips of the Alnico magnet on the SC-2 amplidyne.

For insulation cleaning, checking windings and greasing bearings, see "Motor Care." The SC and SC-1 amplidyne bearings should be packed with a light grease such as Beacon M-285. Use Navy Grade 14L3-C lubricant in the SC-2 amplidyne. After greasing, all machines with two grease plugs per bearing should be run for 15 minutes with both the filler plug and relief plug removed, so that excess grease may be thrown out.

Clean the ventilating screens so that the machine will not run hot. An increase of approximately 10° C. in operating temperature will cut the life of the insulation in half.

Upon reassembling, tap the end shields into place gently with a rubber mallet. See that the brush leads are not pinched or left free to rub against the commutator. Unless something is wrong, the parts should go together easily. If mating parts are jammed or out of line, drawing them together by tightening the stringer bolts will cause more trouble.

If, after reassembling, the residual voltage is higher than 10 or 20 volts, the cause is probably loss of flux in the Alnico poles which activates the demagnetizing windings. This is not serious when the amplidyne is connected in the antenna position control system. The a-c component of the half-wave rectified field current from the control amplifier will act to remove residual flux from the field. With zero field current, if the output voltage is in the neighborhood of 200 or 300 volts, the brushes have been shifted too far in a direction opposite to rotation. Check that the direction of rotation is correct; it should be clockwise as viewed from the amplidyne end.

Proper brush setting can be determined by the amplification factor as follows: The SC and SC-1 amplidynes, 5AM45DB5, should require between 13 and 21 milliamperes in a 400-ohm field to produce a 150-volt output; and not more than 45 milliamperes to produce 250 volts. The SC-2 amplidyne 5AM73AB58 should require between 8 and 15 milliamperes in one 440-ohm field to produce 150 volts output; and not more than 30 milliamperes to produce 250 volts. The values at 150 volts should be observed for both increasing and decreasing values of field current. If a control amplifier is used for excitation, the current value stated above will be the difference between the readings of two d-c milliamperes placed in the leads between the amplidyne fields and the 6L6 vacuum tubes.

Sensitivity can be decreased by shifting the amplidyne brushes in the direction of rotation. An angular shift of 5° may cause as much as a 2-to-1 change in amplification.

In an Emergency: The SC-2 amplidyne will perform properly in an SC or SC-1 system if the control amplifier is modified to correspond to the SC-2 amplifier, Navy Type CG-50ABN. This change entails adding a 270-ohm 2-watt resistor in the cathode circuit of each 6L6 vacuum tube, and replacing the 51,000 ohm 1-watt resistor in the feedback circuit with a 1,000 ohm 1 watt resistor.

In general if the proper amplidyne for a particular system cannot be obtained in the time available, try any amplidyne which is at hand and is reasonably near the proper output rating. The temporary control system may work smoothly after minor changes such as adjusting the

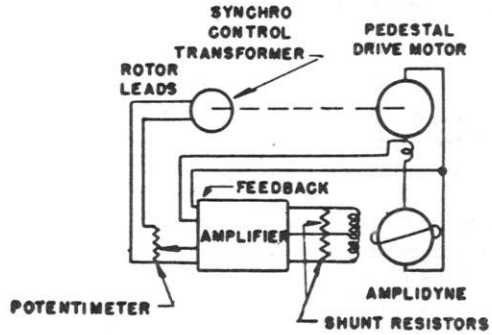


FIGURE 3.—Reducing sensitivity of amplidyne position control.

amount of antihunt or feedback. If not, see whether the system still oscillates after checking that the amplidyne rotates in the proper direction (clockwise from the amplidyne end on most machines) and trying reversal of feedback or other connections. If connections are correct and the system is still troublesome, disconnect the error signal input to the amplifier. If this does not stop the oscillation, the cause is within the feedback loop. The feedback loop goes from the amplifier output to the amplidyne field, then directly from the amplidyne output back to the amplifier input.

If removing the error signal input does stop the oscillation, reduce the gain of the amplifier. Some amplifiers may have a built-in gain control. If not, shunt the amplidyne fields with a pair of wire-bound resistors of between 50 and 500 ohms each.[2] (See fig. 3.)

Another method of reducing gain would be to insert a potentiometer between the R_1, R^2 leads of the 5CT synchro and the control amplifier input (fig. 3). Its resistance should be in the region of 1,000 to 5,000 ohms. The internal elements of the amplifier may be altered, but this is

dangerous unless one is thoroughly familar with the amplifier.

If a position control system cannot be made to operate, the antenna can be operated by a speed control which has no possibilities of oscillation.

If the indication of the antenna's position is independent of the control system, as it is on the SC series of equipments, accuracy of bearing indication will not be impaired by use of a speed control. Disconnect the amplifier completely and connect a source of d-c to the amplidyne fields by means of a potentiometer. Six-to-fifteen volts from a few dry cells should be sufficient. A d-c slewing motor armature is supplied with voltage by exactly the type of control desired for exciting the amplidyne fields. (See fig. 4). A wire wound resistor in region of 2,000 ohms placed in series with the amplidyne field will help to spread out the potentiometer control. With this type of control, it may be difficult to keep the antenna from creeping.

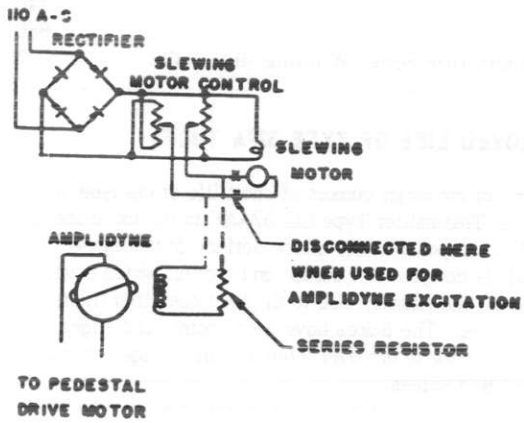


FIGURE 4.—Temporary speed control.

Of course, these measures are to be taken only in cases of dire necessity such as battle damage might require.

If neither amplidyne nor amplifier is available, an ordinary d-c generator may be used to drive the pedestal motor. Any source of d.c. which will supply at least 70 volts and 0.6 ampere will be sufficient to drive an SC, SC-1, or SC-2 antenna. The selenium rectifier in the control unit will operate the antenna drive motor directly, if necessary, provided the rectifier is cooled with a fan so that it never exceeds 70° C. Do not include resistors R-105 and R-108 in the circuit. Connect the d.c. to motor leads A_1 and S_2. Don't use the A_2 lead, TB 12-6.

Important. When nonstandard parts must be used, make certain that the ship's radar officer and operators fully understand the liminations of the equipment.

As an example, an SC amplidyne will turn a SC-2 antenna, but will not drive it at high speed unless an SC or SC-1 amplifier, Navy Type CG-50AAG, is used with it. Also, the SC amplidyne would be overloaded on PPI operation.

An SC amplidyne can be used for intermittent rotation of an SK antenna, but operation in a strong wind or on sector sweep should not be attempted. Torque on an SK antenna due to a strong wind would badly overload an SC amplidyne.

Typical Operating Voltages and Currents in Control System

TABLE A

	SC AND SC-1 PEDESTAL SPEED		SC-2 PEDESTAL SPEED	
	0 r. p. m.	4½ r. p. m.	0 r. p. m.	4½ r. p. m.
Control unit amplifier input a-c voltage across terminals TB 12-7 and TB 12-8 (error signal voltage).	----------	5 to 10------	----------	8 to 15.
Amplidyne input field currents in milliamperes at terminals TB 16-1 and TB 16-2.	20 and 20----	5 and 35----	20 and 20----	10 and 30.
Amplidyne output, terminals TB 16-2 and TB 16-5—d-c volts.	0 to 30------	180----------	0 to 10------	190.
Amplidyne output, terminals TB 16-2 and TB 16-5—d-c amperes.	0 to 0.5------	0.4----------	0 to 0.4------	0.5.

Resistance Values of Amplidyne and Pedestal Motor

TABLE B

EQUIPMENT	MODEL NO.	LEADS	RESISTANCE (+10%)
SC and SC-1	Motor 5BBY47AB3	A_1–A_2	40
		A_2–S_2	25
		A_1–S_2	65
	Amplidyne 5AM45DB5	A_1–A_2	40
		F_3–F_5	400
		F_4–F_5	400
		F_3–F_4	800
SC-2	Motor 5BBY47AB6	A_1–A_2	15
		A_2–S_2	8
		A_1–S_2	23
	Amplidyne 5AM73AB58	C_1–C_4	28
		F_1–F_2	440
		F_3–F_4	440
		F_1–F_4	880
		Quadrature Series Winding (internal)	7

PROPER PHASE ROTATION OF AMPLIDYNES CG-21905 AND CG-21906

In the SK equipments the amplidynes are driven directly from the power supply through separate starters. For 220- or 440-volt a.c. supplies a 3-phase induction motor is used. Improper phase connection of the power supply to the starter will cause the motor to turn in the wrong direction. The proper direction is clockwise as viewed from the amplidyne generator end. Interchanging of any two of the motor input leads will change its direction of rotation.

In amplidynes, reversal of the direction of rotation does not reverse the polarity of the output. This is because the output is created in two stages, there being a reversal in each stage thus canceling out the effect of the direction of rotation. The short circuit axis flux reverses in direction but the output voltage does not. Direction of rotation is important, however, because the amplidyne sensitivity (output volts vs. field current) is adjusted by displacing the brushes from the neutral axis. If the direction of rotation is reversed, the brushes are effectively on the other side of the neutral axis and the sensitivity is greatly changed with resulting sluggishness or instability of the system.

All a.c. installations of SK amplidynes should be checked for proper rotation.

TRANSMITTER VENTILATION

In the analysis of reports received from field activities it has been determined that the ambient temperature on the inside of the transmitter has been running too high.

The high temperature has been responsible for many component failures within this unit; therefore, it is recommended that periodic temperature readings be taken within the console near the capacitor C-301.

The temperature should not be allowed to reach 120° F. (50° C.) or above. In those cases where the proper ventilation is not available action should be initiated to keep the temperature below 120° F. (50° C.).

IMPROVED LIFE OF TYPE 327A TUBES

One of the major causes of short life of the type 327A tubes in Transmitter Type CG-52AAK is the formation of a thin flaky deposit on the inside surface of the anode. This deposit is composed of carbon and thorium which have been boiled off the filament due to the high operating filament temperature. The flakes have sharp points and edges which cause the tube to arc over internally at voltages considerably below rated values.

It has been found that some improvement in tube life will be obtained if the tube plates are operated at a higher temperature, i.e., at higher power input. The following procedure is recommended.

a. Be sure that the filaments are operated at rated 10.5 volts.

b. Operate the transmitter on the long pulse and as near rated plate voltage as possible.

PROTECTION OF OSCILLATOR GRID AMMETER M-303 (SC-1)

Internal arcing of type 327A tubes causes abnormal voltages to be built up in the pulsing circuit. Sparkovers in switch S-308 discharge the pulsing capacitors C-303 and C-304 through grid ammeter M-303. In order to prevent possible damage to this meter a protective gap has been installed for the grid feed lead where it passes through the horizontal shield into the oscillator compartment. This charge was made in production at the same point as given above for filament socket protective gaps.

Installation of the gap is shown in the sketch of figure 1.

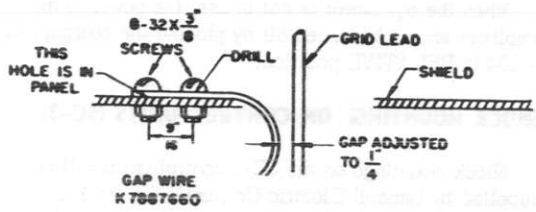


FIGURE 1.

A quantity of these gap wires K-7887660 and mounting screws will be supplied to the installation men. One hole for the mounting screw is already in the shield. The second hole should be drilled in a line between this hole and the grid lead wire and nine-sixteenths inch from it. The gap should be adjusted to one-fourth inch.

MOUNTING OF DUPLEXERS

Field reports have indicated that some duplexers have been so mounted that under certain vibration conditions the inner conductors have vibrated sufficiently to interfere with the air-type spark gap operation.

In such cases the duplexer mounting should be changed in such a way as to move the natural vibration period of the duplexer away from the bad excitation frequencies. In general, mounting brackets should be made as stiff and short as possible, and they should be attached to ship structures which themselves do not exhibit large vibration amplitudes at critical frequencies. When short mounting brackets cannot be used, it will be necessary to include additional bracing to vary the vibration periods.

AIR-GAP ADJUSTMENTS

Analysis of radar operation has indicated that the duplexer spark gaps should be examined at least once every 50 hours to provide optimum radar performance. Reports received from the fleet have indicated the points become burred and pitted after 50 hours of use.

The spark gap points are made from tungsten embedded in silvered brass. They are made up of a stationary contact and a movable contact. Their treatment is similar to the automobile ignition gap.

The points, first, should be wiped clean and dry from sediment and moisture. Then, they should be checked for pits and burs. All pits and burs should be removed by dressing the surface smooth and even with fine emery cloth or sandpaper.

The points, then, should be replaced and adjusted. Make sure that they are lined up. The proper air gap is 0.010 inch, which can be spaced by first screwing the movable contact in until it touches the fixed contact, and then backing it out one quarter turn and locking securely.

MINIMUM RANGE ON AJ RECEIVER

When the new AJ receiver is placed in the SC-2/SC-3/SK/SK-2 the range out to 4 miles is blanked out on the Master PPI due to the Main Bang. However, this condition can be cleared up by adjusting the video balance control (R-4056) on the AJ receiver, so as to invert the pip on the "A" scope.

It has been found that the best position of the video balance control (R-4056) is about two-thirds clockwise—just before saturation of V-4013. As stated in the instruction book, the AVC switch S-4001 should be in position 3 for most sensitive minimum range; but in position 1, sensitivity should be reduced sufficiently following the transmitted pulse to prevent close echoes from being overloaded.

MAINTENANCE OF THE CALIBRATING OSCILLATOR

In case of failure in the SC/SK series calibrating oscillator the following maintenance routine is to be followed:

a. Clean and brighten the plugs of the crystal holder. After replacing the crystal holder in the crystal socket a check for electrical continuity between the holder and the socket should be made.

b. If the trouble still persists, replace the vacuum tube 7N7 (V-707) in the receiver-indicator.

c. If steps (a) and (b) do not restore oscillation, the fault may be in the crystal.

Cleaning the Crystal: If the crystal is not damaged it is possible, in some cases, to cause an apparently defective crystal mounted in a nonhermetically sealed holder to operate by opening and cleaning the holder and the crystal. Suitable cleaning agents are grain alcohol (U.S.P.) and carbon tetrachloride, the latter being familiar commercially as Carbona or the colorless Pyrene fire extinguisher fluid. In either case, the cleaning fluid must be pure, containing no adulterants or denaturants. Due to the tendency of carbon tetrachloride to break down when in contact with some metals for periods of time, or to its ability to dissolve rubber slowly, carbon tetrachloride should be used only if it has been stored in a bottle having a cork or glass stopper. After the crystal has been thoroughly and carefully washed and dried, the surface of the crystal must not be permitted to come in contact with the fingers or anything which would render the crystal or electrode surface unclean. Clean, lintless cloth, tissue paper, or filler paper are suitable handling mediums for the crystals. Similarly, the faces of the electrodes which come in contact with the crystal must not be handled directly after cleaning. With strict adherence to scrupulous cleanliness throughout, this procedure should be effective if the trouble is due merely to dirt or moisture in the crystal holder.

a. If satisfactory operation does not result, the crystal should be replaced.

b. In cases of operation at high humidities, it may be found that control KK (C-718) does not have sufficient range to allow synchronizing the 82-kilocycle oscillator with the crystal when in "calibrate" position. Improvement in the range of control KK may be made by changing C-717 from 220 $\mu\mu$f.

REPLACEMENT OF CAPACITOR C-4033 (RECEIVER CG-46ACQ)

Purpose: This change is made to prevent a long recovery time due to saturation of the recond I-F stage by the transmitted pulse. This condition shows up as a lack of "grass" and weak exhoes out of 20,000 yards, with normal sensitivity beyond that point.

Equipments Affected: All SC, SC-1, SC-2, and SK radar equipment to which a Replacement Receiver Type CG-46ACQ has been added.

Material Required: One 220 $\mu\mu$f capacitor (Navy Type 481626-B5, G.E. Designation K-27J362P20).

Procedure: a. Remove receiver shock mount and base plate.

b. Unsolder C-4033)2200 $\mu\mu$f mica capacitor) from cathode (terminal 5) of V-4006.

c. Replace with the 220 $\mu\mu$f capacitor—use as short leads as possible.

d. Make sure all screws are replaced snug in cover and shock mount.

Changes in technical manual: On the schematic wiring diagram of the Replacement Receiver Type CG-46ACQ, the value of C-4033 should be changed to read 220 $\mu\mu$f. The parts list should also be changed accordingly.

General: The post card included in the modification package should be filled in by the person who makes the modification and mailed.

STEP MARKER TUBE V-704

With some V-704 tubes in Receiver-Indicator Type CG-46ABJ (step marker—IFF amplifier) it will be found that the step marker is somewhat rounded at the break points making accurate ranging difficult. This effect is particularly noticeable when the step is close to the start of the trace. The effect is due to slight tube characteristic differences in standard tubes.

A simple remedy is to switch 6SN7 tubes in the indicator unit until one is found which will provide a sharp step marker. Approximately 80 percent of the tubes will be found to have proper characteristics to provide accurate markers.

OPERATION OF CONTROL AMPLIFIER TYPE CG-50AAG

Control Amplifier Type CG-50AAG receives its power from the synchro excitation bus O.S.C. phases. Power to the amplifier is not controlled by S-101 and accordingly, the amplifier draws power whenever the synchroexcitation bus is energized.

When the equipment is not in use, the power to the amplifier should be turned off by placing the bearing switch S-104 in RELATIVE position.

SHOCK MOUNTINGS ON CONTROL UNITS (SC-3)

Shock mountings on the SC-3 control units will be supplied by General Electric Co., until the stock of mountings now on hand at Schenectady has been exhausted, after which time the mounting bolts only will be supplied. Mounting straps will replace the shock mountings at the time of installation. These are being supplied as a part of the PPI equipment.

At the time of installation the shock mounting should be removed, and the mounting screws in the shock mounting used with the straps provided on the PPI unit to mount the control unit solidly to the PPI unit.

Similar instructions will be found on tags attached to all SC-3 control units.

MAINTENANCE OF CONTROL RINGS AND FINGER ON DEFLECTION COIL YOKE

The following important maintenance information for Master PPI Type CG-55ACC and Remote PPI Type CG-55ACD covers servicing of contact rings and fingers on cathode ray tube deflection coil yokes.

a. If the pressure between the contact fingers and the rings on the deflection coil yoke is excessive, the contact surface between the fingers and rings may wear and remove some of the silver in the form of dust. After a period of operation, the resultant dust may accumulate between the rings, thereby providing a low impedance path between the rings which will cause improper operation. The effect of such trouble would be to cause the calibration of the oscilloscope to bunch near the center of the tube, and in general make it difficult to properly calibrate the unit on all ranges. In addition to disturbing the calibration, there would be a shortening of the sweep distance.

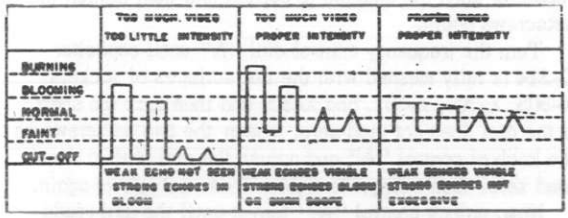
b. In order to avoid the condition, the contact rings and fingers must be kept very clean (particularly the space between the rings), and the contact pressure between the rings and wiper fingers should be maintained at approximately 3 ounces. If no scale or convenient way of measuring the pressure is available, the fingers should be adjusted for just sufficient pressure to maintain contact with the rings.

ADJUSTMENT OF SC/SK SERIES MASTER PPI

It has been found that improper adjustment of the PPI bias, intensity video, and gain controls has been responsible for relatively poor performance characteristics in the detection of small echoes at long ranges.

In order for an intensity modulated scope, such as a PPI, to indicate weak signals, the intensity control (bias) must be adjusted to give a faint trace when the receiver gain is at a minimum and no signals are fed to the indicator. When this condition is obtained, even the weakest echo will intensify the screen and give a visible response.

At the maximum end of the intensity scale, the video limiting control must be set to prevent the strong echoes from "blooming" or burning the scope. The comparison shown below will illustrate the proper and improper conditions.



Procedure for the adjustment of Master PPI:

a. Adjust receiver gain to minimum. Adjust video gain (R-2025) full left.

b. Set PPI for faint trace with slight after-trace, using intensity control (R-2200). If trace is not slightly dimmer at center than about three-fourths of the way out, adjust (R-2426) in connection with R-2200 for this effect.

c. Set the receiver gain for normal grass height, and train for saturated echo.

d. Adjust R-2025 for bright trace just short of blooming and acceptable to eyes of the operator.

e. Intensity of echoes should be set by (R-2025) and not by (R-2200).

f. A setting of (R-2025) which is acceptable to the average operator should be found and left in that position.

g. Operators should be encouraged to set the intensity as follows each time range scale is changed:

(1) Receiver gain minimum.

(2) Adjust intensity for faint trace with slight after-trace.

(3) Receiver gain normal.

CARE AND OPERATION OF DEHYDRATING UNIT

With each equipment is supplied a small compressor, dehydrating unit, and nitrogen tank. The dehydrator is to be used for initially drying out the line and maintaining approximately 5 pounds per square inch of air pressure. In case of failure of the dehydrator the nitrogen tanks are available to keep the line dry until repairs are made to the unit.

Pressure is automatically maintained within an adjustable differential by means of a diaphragm switch. Therefore, if the dehydrator turns on frequently to maintain such pressure the line should be checked for leakage.

Particular attention should always be given to reactivating the silica-gel cartridge after the initial drying out of the line, or whenever the indicator discolors or shows pink. To reactivate the silica-gel dehydrator proceed as follows:

a. Remove the silica-gel cartridge by opening the inlet and outlet lines.

b. Remove indicator unit (marked with blue end bands) and set aside.

c. Place silica-gel cartridge (less indicator) in oven at 350° to 375° F. for 4 to 5 hours.

WARNING: Temperature of oven should not reach 400° F. as the end caps are sweated on with solder which melts at approximately 400° F.

d. Replace indicator unit and cartridge and then tightly seal both ends of the line.

e. Unit is now ready for operation.

Special attention is directed to step (b) which calls for the removal of the indicator before the dehydrator cartridge is heated for reactivation as the lucite plastic envelope indicator will soften at 175° F. It is not necessary to reactivate the crystals contained in the indicator since they represent a very small proportion of the amount contained in the main silica-gel cartridge and are automatically reactivated when the dehydrator is put back in service.

STATIONARY FALSE ECHOES

Reports have mentioned that two stationary false echoes occur at 311 and 375 miles. They looked like pips but were actually raised places in the base line. They occurred at all antenna positions. Tuning of the RECEIVER TUNE and OSCILLATOR of the AJ receiver brought the humps closer together until only one spot remained which was 3/8 inch high and 3/8 inch wide.

Turning the Master PPI off got rid of the effect. So did changing the 6V6 in socket X-2401.

This condition was observed several times in the Bridgeport lab. It was found that, in the V-2401 circuit, certain 6V6 tubes would tend to oscillate weakly as a Barkhausen-Kurtz oscillator. This, of course, could be picked up by the receiver, and spurious signals resulted.

The cure is to change V-2401.

EMERGENCY ANTENNA DRIVE MOTOR POWER SUPPLY

Since a number of emergency antenna drive motor power control circuits have been submitted to the Bureau for approval, the following preferred methods are submitted below for your information:

Preferred Method (see fig. 1)

REQUIREMENTS: 115 or 230 v d-c ships power supply.

Symbol	Quan.	Item
S-1	1	Double-pole, single-throw 10a 250 v switch
FB	1	5-amp fuse block
F-1, F-2	2	5-amp fuses
R-1	1	80-ohm, 100-watt resistor for 230 volts supply Navy type 63190; 40-ohm, 50-watt resistor for 115 volts supply Navy type 63186
P-1	1	1,200-ohm, 225-watt potentiometer for 230 volts (R-804 spares) 300-ohm, 25-watt potentiometer for 115 volts (R-803 spares)
S-2	1	Double-pole, double-throw 10a 250 v switch

General: The resistor R-1 is recommended to prevent damage to the drive motor in the event that P-1 is in full voltage position when the switch S-2 is shifted from one power source to the other 180° difference in phase.

First Alternate Method (see fig. 2)

Requirements: 115 or 230 v d-c ships power supply.

Symbol	Quan.	Item
S-1	1	Double-pole, single-throw 10a 250 v switch
FB	1	5-amp fuse block
F-1, F-5	2	5-amp fuses
R-1	1	80-ohm, 100-watt resistor for 230-volt supply, or 40-ohm, 50-watt resistor for 115 v supply
P-1	1	1,200-ohm, 225-watt, potentiometer for 230 volts (R-804 spares), or 300-ohm, 225-watt potentiometer for 115 volts (R-803 spares)
S-2	1	4-wafer, 5-position, 10-amp, 250-volt switch.

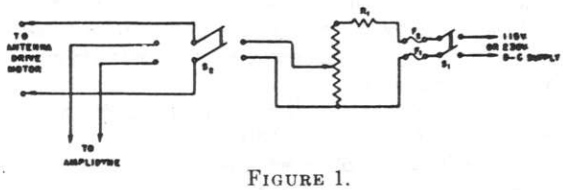


FIGURE 1.

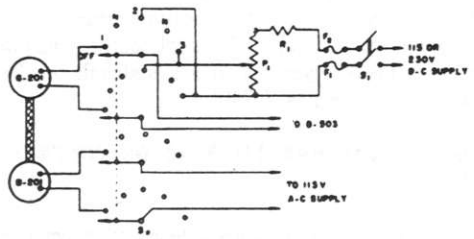


FIGURE 2.

Second Alternate Method (see fig. 3)

Requirements: One 3-pole double-throw 1a 125-volt switch.

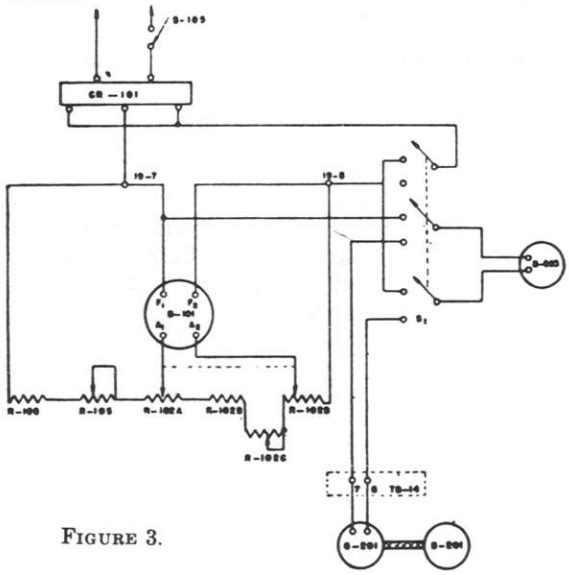


FIGURE 3.

ALINING SC SERIES RING OSCILLATORS

The spacing between the moving part of capacitor C-314 (butterfly) and the flat surface of sockets X-305, X-306, X-307, and X-308 should be five-sixteenths inch plus or minus one thirty-second inch. If it is not, loosen the two setscrews on the hub of capacitor C-314 and adjust the capacitor until the spacing is correct and then tighten the two setscrews again.

Turn the frequency control dial "A" until capacitor C-314 is fully meshed with the flat surfaces of sockets X-305, X-306, X-307, and X-308 and then lock the shaft. If the dial does not read zero, loosen the two setscrews on the knob of control "A" and adjust the dial until it does read zero. Don't forget to tighten these setscrews again.

Now, unlock control "A," turn it until the dial reads 100 and lock the control again. The capacitor C-314 should now be completely unmeshed from the flat surfaces of the oscillator sockets.

With C-314 completely unmeshed and the dial reading 100, check the position of the grid tuning disks (lollipops) with respect to the grid coils. The disks and coils should be in the same plane. If they are not, loosen the setsctews on the disks and adjust the disks until they are in the same plane with the coils. When these disk setscrews are finally tightened down again, the alignment is completed.

MODEL SC/SK REPLACEMENT ANTENNAS

During the last 18 months of World War II there was an increasing number of failures of the antennas of the SC/SK equipments, due to deterioration. In an effort to remedy this condition, The Electronics Division of the Bureau of Ships developed and procured a quantity of stainless steel antennas to be used as a replacement for all SC-series and SK-series antennas.

This new antenna is being furnished in two frequency bands, blue (NT-66ALA) and yellow (NT-66ALB). A total of 42 blue-band and 41 yellow-band antennas have been distributed to major Naval activities, and are available for immediate use as replacements. Since only 23 sets of grid coils and tuning stubs (11 yellow and 12 blue) were procured originally, it is requested that the present antenna color be retained where practicable.

The antenna pedestal is a new design which improves the accessibility and serviceability of the synchros and gears. A fixed subbase and pedestal column support the stationary section of the pedestal transmission line, the drive motor, three synchros and a 2-compartment gear box. The pedestal shell, which revolves about the pedestal column on an upper and a lower bearing supports the reflector. The 66ALA and 66ALB reflectors are similar to those in the SK-3 array. They scan in azimuth at approximately 5 r.p.m. with a beam measuring about 22° in the horizontal plane and 40° in the vertical, as compared to an SK-3 beam of 22° in the horizontal and 16.5° in the vertical.

The antenna servosynchro system is a duplicate of the standard SC/SK antenna with the exception of the antenna drive motor which has a separately excited field. A

rectifier power unit (CRP-20AEK) is shipped with each new antenna to supply d.-c. energy to the separately excited field of the drive motor. All presently installed SC/SK series antenna drive motors, with the exception of the SC-5, have permanent-magnet type fields. The rectifier power unit (CRP-20AEK) is not required when an SC-5 antenna is replaced by a new 66ALA or 66ALB antenna since a similar power unit has been incorporated in the SC-5 control unit. When an SC-1 antenna is being replaced, the 21AAE amplidyne must be replaced with a 21ABU amplidyne.

The following drawings have been distributed to major Naval activities to assist in the installation of the 66ALA and 66ALB antennas:

RE 66J 576A	Outline and mounting.
RE 66J 596A	SC-1 interconnecting wiring.
RE 66J 597A	SC-2 interconnection wiring.
RE 66J 598A	SC-3 interconnection wiring.
RE 66J 599A	SC-4 interconnection wiring.
RE 66J 600A	SC-5 interconnection wiring.
RE 66J 601A	EK interconnection wiring.
RE 66J 602A	SK-2 interconnection wiring.
RE 66J 603A	SK-3 interconnection wiring.

Attention is invited to BuShips condifential letter Serial C-982-790 (982) over C-EN28/A2-11 dated 7 August 1945 in regard to the maintenance of shipboard radar antennas. A quantity of SC-2 and SK dipoles and feedlines have been distributed to major Naval stocking activities for the repair of these antennas. Antennas removed from shipboard requiring minor repairs should be reconditioned as soon as possible and placed in stock for reissue. Miscellaneous parts should be salvaged from antennas that are beyond economical repair. Replacement of antennas beyond economical repair must be specifically authorized by the Bureau of Ships because in some cases weight and moment compensation will be required.

INTERFERENCE TO RADIO COMMUNICATION SYSTEMS

In order to eliminate interference to radio communication receivers from SC and SK Series radar, type 53153 interference filters are available and may be drawn through supply channels.

SC/SK ANTENNA IDENTIFICATION

Certain operating frequencies of SC, SK, and SRa radar equipments cause interference with commercial television services. In order to determine corrective measures to be taken, it is necessary to identify the antenna, deplexer, and transmitter coils in use in all installations of these radar equipments.

In many installations, the frequency band color code has been obliterated, making identification difficult. figure 1 is a listing of type numbers and dimensions of antennas and duplexers designed for specific frequencies for SC/SK Series equipment.

SPACING TERMINAL BOARDS IN SC AND SK TO CLEAR CABLE

Remounting the phenolic board which mounts TB-75, TB-74, and TB-73 in Radar Equipment SC and Radar Equipment SK has been suggested.

At the present time, the interconnecting cable on the video unit hits the case due to lack of clearance. This frequently causes the cable to break.

It was suggested that spacers three-eighths of an inch thick be added to lower the entire mounting board and thus provide sufficient clearance. The spacers are inserted between the metal frame and the terminal board on the mounting screws. The existing mounting screws must be replaced by screws which are three-eighths of an inch longer to accommodate the spacers. Illustrations show spacers installed, figures 1 and 2.

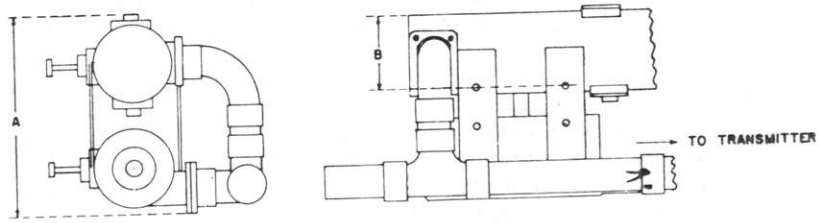
The Bureau concurs in this suggestion and recommends local use where deemed advisable.

SC/SK

ANTENNA & DUPLEXER IDENTIFCATION

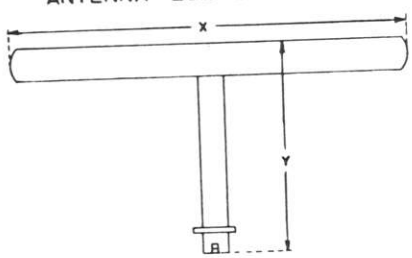
COLOR BAND	FREQUENCY	ANTENNAS									DUPLEXERS								
		SC	SC-1	SC-2	SC-3	SC-4	SC-5	SK	SK-2	SK-3	SC	SC-1	SC-2	SC-3	SC-4	SC-5	SK	SK-2	SC-3
RED	175-185	-	66AAY 66ABC	66ACB	-	-	-	-	-	-	-	50AAP	50AAP	-	-	-	-	-	-
GREEN	185-195	-	66AAZ 66ABD	66ACC	-	-	-	-	-	-	-	50AAQ	50AAQ	-	-	-	-	-	-
YELLOW	195-205	-	66ABA 66ABE	66ACD	66AET	66AET-1	66AJE	-	-	-	-	50AAR	50AAR	50AAS	50AAS	50AAS	-	-	-
BLUE	215-225	-	66ABB 66ABF	66ACE	66AEU	66AEU-1	66AJF	-	-	-	-	50AAS	50AAS	50AAS	50AAS	50AAS	-	-	-
YELLOW-GREEN	192.5-197.5	-	-	-	-	-	-	66ABH	-	-	-	-	-	-	-	-	50AAR	-	-
BLACK	212.5-222.5	-	-	-	-	-	-	-	66AFR	66AFR	-	-	-	-	-	-	-	50AAS	50AAS
-	180	66AAJ 66AAK	-	-	-	-	-	-	-	-									

DUPLEXER SC/SK



DUPLEXER	COLOR	FREQUENCY	EQUIPMENT	A**	B**
50AAP	RED	175- 185	SC-1; SC-2	12-7/16	5-7/32
50AAQ	GREEN	185- 195	SC-1; SC-2	11-11/16	4-27/32
50AAR	YELLOW	195- 205	SC-1; SC-2	10-15/16	4-15/32
	YELLOW-GREEN	192.5-197.5	SK		
50AAS	YELLOW	195- 205	SC-3,SC-4,SC-5	9-3/4	3-7/8
	BLUE	215- 225	SC-1,2,3,4,5		
	BLACK	212.5-222.5	SK-2; SK-3		

ANTENNA ELEMENT SC/SK



COLOR	X**	Y**	EQUIPMENT
RED	25-3/4	8-5/8	SC
GREEN	24-3/8	8-1/4	SC
YELLOW	23-1/8	7-15/16	SC
BLUE	21	7-5/16	SC
YELLOW-GREEN	27	8-1/16	SK

Figure 1. A listing of type numbers and dimensions of antennas and duplexers designed for specific frequencies for SC/SK Series equipment.

Figure1

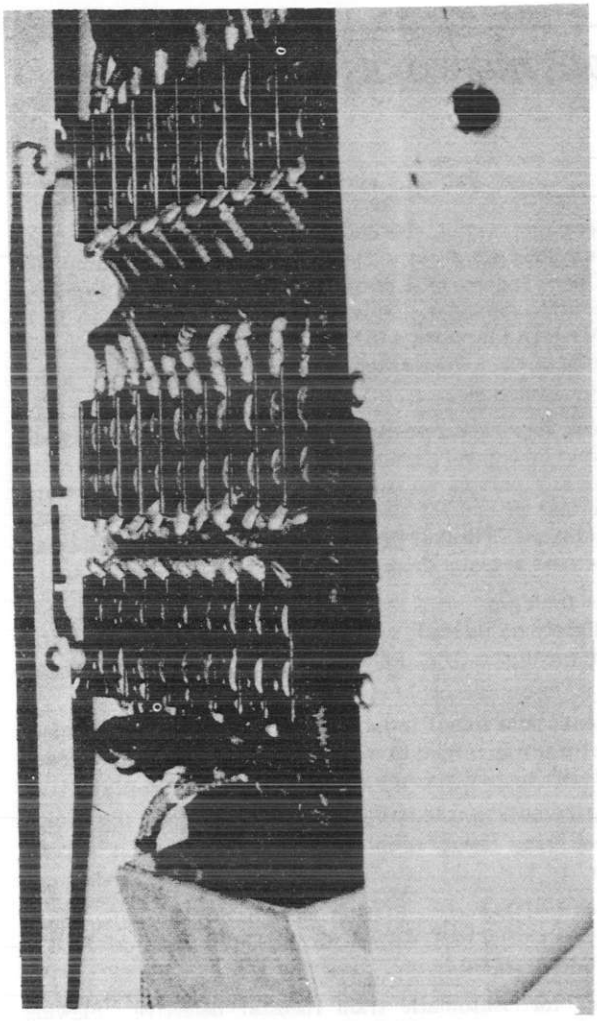


FIGURE 1

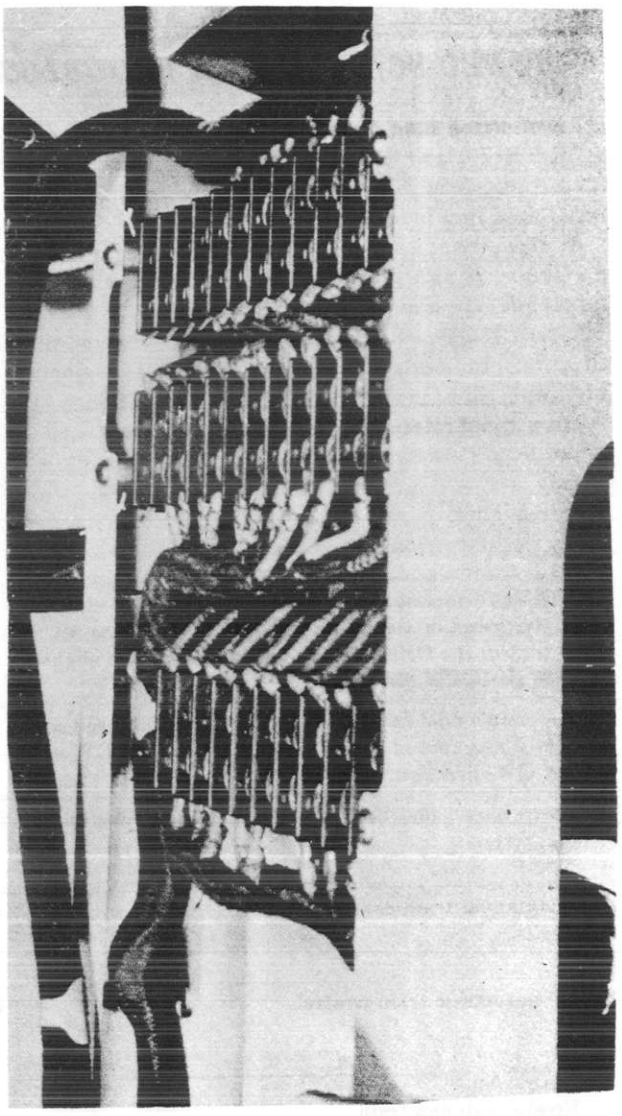


FIGURE 2

MODEL SC/SK SERIES TROUBLESHOOTING NOTES

Antenna and Control System

NATURE OF DIFFICULTY	TROUBLE FOUND AND REMEDY
No rotation.	Check for: Amplidyne not running or defective. Antenna interlock plug out. Defective tubes, control amplifier. Open synchros 5CT or 5DG in control system. Defective control amplifier. Stowing switch in OFF or INTERMEDIATE position (SK). System on TRUE. No gyro excitation. Open antenna drive motor. No main power to equipment.
Low speed rotation only, hunts at high speed.	Check for: Defective tubes, control amplifier. Dirty slip rings on control circuit synchros. High resistance ground on any part of control circuit. Ground on input transformer of control circuit. Defective oil seals SC–2/SK antennas. Brake in SK antenna dragging. Demagnetized antenna drive motor.
The double resistor pot, R–102 A and B, that controls the speed of the slewing motor, B–101, was set so that in the OFF position the motor rotated slightly in the CCW direction.	This fault was corrected by moving the pot R–102B just slightly on its shaft so that no voltage was applied to the motor in the OFF position.
Antenna would fall out of step when R–102 speed control was turned to a maximum either in a CW or a CCW direction.	Antenna was found to be going much too fast when speed control was turned to a maximum. Adjusted R–108 and R–105 to give maximum speed of 4 r. p. m.
Fuses blown had burned terminal board very badly.	Replacement link type fuses should not be used in the control unit. Many terminal boards have been burned due to bad fuse link contact.
No manual train control.	Check for: Defective 5DG synchro in control unit. Hand wheel clutch to 5DG synchro loose. System on TRUE. No gyro signal.
No automatic train control.	Check for: Automatic train rheostat defective. Slewing motor defective. Defective 5 DG synchro in control unit.
Erratic antenna train.	Check for: Dirty slip rings on any control synchro. Cracked or worn amplidyne brushes.
Very jerky bug rotation. Bug had a tendency to motor, especially when S–2204 was thrown.	Selsyn assembly was disassembled and it was found that one of the rotor brushes on the relative bearing selsyn was making intermittent contact due to weak pressure by the spring. Spring was bent so that a good contact was obtained and trouble was corrected.
No indication of antenna train.	Check for: Defective 7G synchro in pedestal or 5F in control unit. "PI–RADAR" switch on MPPI in "PI" Position (SC–2/SK).

Antenna and Control System—Continued

NATURE OF DIFFICULTY	TROUBLE FOUND AND REMEDY
Bearing indicator erratic, false readings.	Check for: Dirty slip rings on indicator synchros. Pitted brushes. Remote repeaters reflection on operation of control unit repeater. Repeater winding. Antenna synchro not properly zeroed.
True bearing indicator false readings.	Check for: Open stators. Reversed rotors. Reversed stators. Repeater not zeroed.
Rotation in one direction only, hunt in other.	Check for: One side of amplidyne output grounded. Defective tubes, control amplifier. Defective amplidyne field. Defective control amplifier. Antihunt control improperly set.
No automatic control of antenna train.	Selenium rectifier defective. Check d-c voltage output. Automatic train control on control unit burned out. Check continuity.
No manual control of antenna train.	Taper pin connecting gear from manual hand wheel to differential generator synchro (B–104) missing.
Antenna trains in one direction only without control.	One 6L6 in control amplifier defective. Replace. Transformer T–152 control amplifier defective. Winding supplying plate voltage to one type 6L6 tube shorted or open. Replace transformer. Shorted capacitor C–152 in control amplifier. Defective amplidyne field. Check continuity.
Antenna hunts violently after sudden turning.	Antihunt adjustment R–163 on control amplifier defective or misadjusted. R–163 is set to its proper position when the a-c error signal voltage, as measured with a high impedance meter measured at the input to the amplifier, reaches a max. of 30 or 35 volts on sudden reversal of the d-c voltage supply to motor B–101. Setting the potentiometer too far in the counter-clockwise direction will limit the maximum acceleration of the antenna so that it will fall out of step on reversals. Setting the potentiometer too far in the clockwise direction will cause the antenna to hunt violently.
Antenna hunts when control system energized.	Polarity of amplidyne output reversed. Reverse either the amplidyne armature or antenna drive motor. Check field connections to amplidyne and reverse if other reversals do not help. R–153, C–154, C–155, R–151, R–152 defective.
Antenna trains in one direction, hunts in other. (SK series only.)	In one instance a peculiar condition was noted on an SK where the antenna was located so that the interlock faced the bow. In heavy rain storms, rain was driven into the interlock assembly actually grounding one side of the plug. If you have occasion to experience this trouble, make up a heavy rubber gasket to fit around the male member of the plug assembly.

Antenna and Control System—Continued

NATURE OF DIFFICULTY	TROUBLE FOUND AND REMEDY
Antenna trains in one direction, hunts in other.	One side of interlock plug assembly in antenna grounded. Check to see if interlock link has cut through rubber gasket to ground. Output of V–152, V–153 on one triode section of V–151 low. Replace. A ground on the armature circuit of antenna driving motor, the control amplifier or the amplifier circuit which will show up on the amplidyne, output terminals in the control unit. A resistance of 50,000 ohms to ground will allow the antenna to follow its control up to 3 or 4 r. p. m. before falling out of step. Normal resistance to ground should be several megohms. Windings or cabling may be damp. If ground cannot be easily found or removed, as a temporary measure, restore normal operation by disconnecting, within the amplifier, the wire which connects to ground terminals 1 (tube shell) on tube sockets X–151, X–152, X–153. Whenever the tube shell grounds are removed the amplifier should be plainly marked with a warning tag since the tube shell may be at high potential. Replace the ground wire when trouble is found. Defective capacitor C–151 in control amplifier.
Antenna trains at low speeds, hunts at high speeds.	Output of control amplifier tubes low. Replace. Low amplidyne output. Check brushes and brush connections. Check continuity of armature. Ground on T–151, input trans. control amplifier. Check by removing amplifier from control unit. Operate the system with amplifier insulated from ground. If condition corrected, replace with new transformer or amplifier. Dirty slip rings and contacts on any of the control system synchros. Check and clean. Anti-hunt control on control amplifier out of adjustment. Antenna drive motor demagnetized or oil soaked. Indicated by an overheated amplidyne and drive motor drawing too much current.
Antenna trains at low speeds, hunts at high speeds. (SC–2 and SK only.)	Oil leaking from top housing through defective seal into motor and synchros. On SC–2 have Field Change 18 (grease packing of SC–2 pedestal) made at first availability. On SK have seal replaced or if necessary as a temporary measure use heavier oil.
Antenna trains at low speeds, hunts at high speeds. (SK series only.)	Magnetic brake dragging. Brake needs adjusting so that when brake coil is energized the brake band opens completely allowing free rotation of antenna.
Antenna sluggish in response to train order from control unit.	One winding or connection of B–501 or B–104 is defective. Antenna pedestal not lubricated. Weak tubes V–151, V–152 or V–153.
Antenna train opposite from applied order.	LOCAL-PPI switch control unit in PPI position with PPI not on.

Antenna and Control System—Continued

NATURE OF DIFFICULTY	TROUBLE FOUND AND REMEDY
Antenna brake will not open.	STOW-OPERATE switch in STOW. Brake needs adjusting. Spring tension too high. Adjust as per service bulletin on SK brake adjustment. Check to see brake coil has sufficient voltage to pull the armature in completely. The cabling to the brake coil from the control unit should be paralleled to avoid possible line drops. If voltage is not high enough, armature will chatter and will not seat properly. Under these conditions large currents will be drawn causing the coil to burn up.
Antenna train erratic.	5DG synchro in control unit (hand wheel) has dirty brushes on slip rings. Brushes partly open. Check resistance. Clean slip rings, adjust brush tension. 5CT synchro in antenna pedestal having same ailments described above. Check as above. Dirty or cracked amplidyne brushes. Clean or replace worn and cracked brushes. Loose or high resistance connections in control circuit.
Antenna trains but no indication on control unit repeater.	7G synchro in pedestal defective or 5F in control unit defective. Check continuity of synchro windings. Refer to instruction book for resistance values of synchros.
Antenna trains but no indication on control unit repeater. (SC–3 only.)	7G synchro shaft in pedestal snapped. Antenna must be removed. Do not attempt antenna train.
Antenna trains but no indication on control unit repeater. (SC–2 and SK only.)	PI-RADAR switch on MPPI in PI position.
Antenna bearing erratic.	7G synchro in antenna pedestal intermittent. Check resistance of synchro. Suspect dirty slip rings and pitted brushes. Check that synchro is securely bolted and not liable to jar loose and turn. 5F repeater synchro in control unit having same ailments described above. If repeater does not make full rotation, suspect open stators or rotors. Check as above. Remote bearing switch ON, sometimes loads down the antenna repeater causing jumpy operation. Dirty contacts on open coils in remote synchros will reflect back on the antenna bearing indicator. 5F repeater synchro in control unit mechanically binding. Take cover plate off bearing indicator dial and check for free rotation. A small amount of free play is normal in the "bug" antenna indicator. If you suspect the "bug" to be jumpy, observe the rotation of the MPPI sweeps. Since in relative bearing, the same synchro signal drives the sweep of the MPPI and the "bug," if the sweep rotation is smooth, the "bug" is normal. If the "bug" synchro were defective on winding, the condition would repeat on the MPPI sweep.
Antenna bearing repeater not reading zero when antenna pointed at bow.	Ascertain if synchro repeater in control unit is normal and corresponding with other repeaters. The 7G synchro in the pedestal must be rezeroed, that is turned so the control unit synchro reads zero on the relative dial with the antenna pointing at the bow. Be sure 7G is securely bolted after this operation to prevent future slippage.

Antenna and Control System—Continued

NATURE OF DIFFICULTY	TROUBLE FOUND AND REMEDY
Antenna bearing synchro repeater starts off like a motor when excitation applied.	Dirty slip rings, poor brush contacts on rotor rings, or clamping ring not functioning properly. "G" type machine installed in place of "F" type. Shorted stator leads.
Step-by-step gyro repeater oscillates.	Step-by-step repeater coil open.
Antenna "bug" does not stay on same true bearing as ship changes course, but goes in opposite direction.	36 speed gyro excitation reversed. Reverse S1–53 of 36 speed in control unit.
Antenna jerks at same spot each revolution as indicated on control unit bearing repeater.	The rotor slip rings and brushes on 5CT synchro B–501 in pedestal may be covered with oil or dirt. Clean synchro to insure good contact between brushes and slip rings. Check 5F repeater in control unit for same troubles.
Maximum antenna speed too slow or fast.	Adjust R–105 in control unit adjacent to selenium rectifier.
True bearing inner dial reads 180° out with gyro.	Reverse R1–2 to 5F (B–103) true bearing single speed repeater.
True bearing inner dial rotates in opposite direction from gyro.	Reverse S1–83 to 5F as above. Since the control unit synchros are electrically zeroed at the plant before shipment no further zeroing should be needed.

Transmitter

No power to transmitter.	Line fuses blown. Replace. Transmitter interlock open, safety switch open. Check for interlock continuity. Overload relay tripped. R–301 shorted to ground. R–309 or 310 shorted. C–301, C–310, C–311, C–312, C–313, C–303 or C–304 defective.
Filaments lighted. No oscillation.	R–301, R–302, or T–302 open. V–301 or V–302 defective or unconnected. S–302 in wrong position or faulty.
Filaments not lighted. Indicator light lighted.	T–309 open. Wiring error.
Filaments lighted. Indicator light out.	R–306 open. I–301 burned out.
Incorrect receiver synchronization.	R–303 wrong value or shorted. R–330, R–336 shorted or open. Filament by pass capacitors C–301, C–313 shorted. P–304, C–302 shorted to ground.
Grid current reading zero. Operation normal.	C–305 or M–303 shorted. M–303 damaged.
Plate current reading zero. Operation normal.	C–306 or M–302 shorted.
Filament voltage reading zero. Operation normal.	M–301 open.
High currents. Operation normal.	Shunt on meters blown. Shields loose.
Erratic oscillation.	Defective 327A oscillator tube. Improper loading of transmitter. Spacing of coils to "flippers" to small. Clean and adjust. Stators or rotor of capacitor C–314 marred, dusty or too close. Sharp edges on filament jacks. Dirt in coaxial output line.

Transmitter—Continued

NATURE OF DIFFICULTY	TROUBLE FOUND AND REMEDY
Transmitter double pulsing.	C–303, C–304, T–301, T–302, T–310 shorted or primary open. C–302, R–304, R–313, R–315, V–303, M–303 or tuning adjustments. Grid resistance setting incorrect. Readjust and retune.
Low power output.	Bad connections. Low filament voltage. Tuning bad. Defective 327–A oscillators. Dirty transmission line.
Overload relay fails to reset.	Excessively low line voltage, plunger on relay reset coil mis-set or sticky. Open circuit in relay reset wiring.
Transmitter fails to take normal operating voltage. Overload trips out.	Defective oscillator tubes 327–A's. Replace. Shorted oscillator tube sockets or making poor contact. Check, clean and repair. Capacitors C–301–C–303 defective. Loose connections in oscillator section. Coupling between shaft and plate voltage Variac in control unit loose. If this coupling is loose the Variac arm will not come back to zero when the transmitter is shut down thus applying full plate voltage to the tubes immediately when the transmitter is again fired up. Tighten coupling.
No oscillation.	Check for: Defective rectifier tubes. Defective oscillator tubes. Defective pulsing tube.
Transmitter not loading properly.	Partially shorted coaxial line to antenna. Check line with megger. Possibly open. Line may contain water.
Inoperative pulse monitor scope.	Tubes defective in monitor unit. Check 5U4G rectifier. Check banana plug connections to monitor unit. Check interlock.
Transmitter filaments not lighting when plate Variac control was turned up.	Trouble due to micro-switch controlling relay K–301 in transmitter not closing. Cam on plate Variac shaft did not depress micro-switch lever far enough. Placed shim under the micro-switch lever which allowed the contact to be depressed properly and to operate normally.
No power to transmitter.	Check for: Interlocks open. Fuses open. Overload relay tripped.
Double pulsing.	Check for: Incorrect tuning. Grid resistance setting needing readjustment. Insufficient plate voltage. Defective oscillator tube(s). Defective pulsing tube.
Low power output.	Check for: Defective oscillator tube(s). Mistuned system. Low filament voltage. Bad coaxial joints and connections. Low plate voltage. Coaxial line inpregnated with moisture.

Receiver-Indicator

"A" scope presentation has double trace.	Transmitter plate voltage too low, advance plate voltage. Not enough synch voltage; advance main synch pot. in transmitter. Advance synch control vv on indicator panel.
"A" scope presentation has double trace. (SC–2, SK only).	Transmitter double pulsing, increase grid resistance setting on transmitter. Defective transmitter oscillator tubes type 327–A.

Receiver-Indicator—Continued

NATURE OF DIFFICULTY	TROUBLE FOUND AND REMEDY
"A" scope presentation has double trace. (SC–3/SK–2 only.)	Defective 5R4GY in pulsing circuit of transmitter.
A small echo which varies with plate voltage settings observed on "A" scope 2d and 3d ranges.	Transmitter double pulsing. Change grid resistance or retune. May be defective oscillator tube type 327–A.
Corona and arcing.	Check for: Improper loading of transmitter. Flippers too close to coils. Sharp edges. Dirt in coaxial lines. Side shields loose. Loose contacts at oscillator tube(s).
Incorrect receiver synchronization.	Check for: R–303 shorted or wrong value. R–330 through R–336 shorted or open. Filament by-pass capacitors shorted. Sync cable shorted to ground. C–302 shorted to ground.
Will not take normal voltage.	Check for: Defective oscillator tube(s). Shorted oscillator tube sockets. Filter capacitor defective. Loose connections. Variac arm loose. Dirty coaxial line and connections.
Inoperative pulse monitor scope.	Check for: Defective scope tube. Defective rectifier tube, monitor unit. Banana plug connections defective. Interlock open.
No power on receiver indicator unit as indicated by pilot light.	Check pilot for burn out. See if receiver unit is fully in, so as to engage interlock at rear of receiver chassis. Check line fuses. Check interconnecting cable between control and indicator units.
Jumpy "A" scope trace.	Defective sweep tubes in indicator unit. Loose scope connections and dirty contacts. Defective high voltage rectifier tubes, 2X2 types. Replace.
No sweep on "A" scope.	Check high voltage filter capacitors. Accelerating anode may be off in which case tube will flare when BRILLIANCE control is advanced. Defective "A" scope. Defective sweep tubes. Defective high voltage power transformer in power supply
No sweep on "A" scope. (SC–3/SK–2 only.)	RADIATE switch S–101 on control unit in RADAR SILENT position. In this position there is no sweep on the "A" scope with tuning switch on external.
No horizontal deflection on "figure eight" calibration pattern.	Poor contact to crystal. Remove crystal from holder and clean thoroughly with carbon tetrachloride or pure grain alcohol. Reassemble and place back in socket.
No vertical deflection on "figure eight" calibration pattern.	Plates on tuning capacitor in calibration oscillator shorting together. Bend plates to correct.
Length of "A" scope sweep decreased to about 2/3 normal. All signals compressed.	Defective type 5U4G rectifier in indicator unit. Replace.
"A" scope presentation enlarged greatly and dim.	2X2 type rectifier in high voltage power supply defective. Check accelerator contact on cathode ray tube.

Receiver-Indicator—Continued

NATURE OF DIFFICULTY	TROUBLE FOUND AND REMEDY
Intermittent displacement of sweep (base line).	Clipper-amplifier tube in indicator (V–704) defective. Any defective sweep tubes can cause trouble. Check systematically.
Indicator will not synch with transmitter pulse.	Defective multivibrator tubes. Check. Check connections. Advance vv control on indicator unit.
Trace wobbles back and forth.	Turn control NN to INTERNAL. If this steadies the trace, check trigger pulse line on radar transmitter. Make sure transmitter is on. Vary control vv.
Indicator presentation will not synch with transmitter but will wander off the scope.	Transmitter plate voltage too low, not enough synch voltage to trigger circuits. Raise plate voltage and advance synch potentiometer in transmitter. Synch coaxial line from transmitter to receiver indicator shorted or open. Check continuity from indicator to junction box and from junction box to transmitter.
No range mark on scope.	Adjust vv control on indicator till picture synchs. V–704 defective, replace. Connections to range potentiometer broken or intermittent.
No astigmatism or focus control.	Check controls. Replace "A" scope.
Peculiar behavior of trace, excessive noise, echoes both above and below base line.	Suspect jamming or interference. See section of instruction book on jamming.
Pulses jump up and down erratically.	Check the pulse indicator on the transmitter to see if radar transmitter is pulsing correctly.
High pulses on screen, nonsynchronous, moving slowly or quickly.	Turn antenna and see if intensity changes with direction. If so, these are due to localized interference or pulses from other radar equipments.
Echo pattern present at low transmitter voltage, disappears at higher transmitter voltage.	Decrease the trigger voltage applied to the input of the radar receiver indicator by turning control vv counterclockwise. Do not reduce to point where traee drops out of synchronization.
Transmitter pulse and noise on screen but no echoes.	Check the armored cable between duplexer and receiver for shorts in line and plugs.
No echo pulses on screen.	See that radar transmitter is on. Reduce trigger pulse input to indicator by counterclockwise adjuster of vv. Check all antenna connections and cables.
No signals on "A" scope, transmitter being normal.	INTERNAL-EXTERNAL synch switch on INTERNAL position. Switch to EXTERNAL. Video output cable from receiver to display tube open or not in receiver socket. Check. Receiver detuned. Check tuning. Duplexer arc gaps shorted, duplexer detuned. Check tuning. P–15 coaxial cable from duplexer to receiver shorted or open. Check continuity. Receiver tubes defective. Check for defective GL446's and i-f tubes. Receiver gain control defective or turned down.

Receiver-Indicator—Continued

NATURE OF DIFFICULTY	TROUBLE FOUND AND REMEDY
Receiver response low.	Defective tubes. Suspect GL446 first. Replace, noting improvement if any. Check tuning of trimmer capacitors in r-f section located at left hand side of receiver r-f section. Do not attempt i-f tuning. Check all transmission lines. Check all tuning.
Signals erratic and unstable.	Duplexer tuning capacitors arcing over. Readjust gaps—clean capacitor plates if pitted. Center and retune.
Signals disappear or are very unstable at same antenna bearing each antenna revolution.	Defective antenna rotary joint. Antenna must be removed and rotary joint repaired. If the rotary joint is suspected, observe the plate and grid meters on the transmitter, they will be unsteady and will be deflected considerably if the rotary is bad. IMPORTANT: If the transmitter is tuned right to the grid current dip, its operation may be very unstable and as the antenna radiates into nearby objects, reflections back into the antenna will sufficiently detune the transmitter to cause double pulsing. This condition might be confusing in that the trouble might be attributed to a defective rotary joint. Be sure and check this point before action is taken to remove the antenna. Retune transmitter.
Signals disappear same bearing each antenna revolution.	Check for: Defective rotary joint. Mistuned transmitter, antenna radiation reflection from nearby objects.
"A" scope double tracing.	Check for: Transmitter plate voltage too low. Control VV on indicator set too low. Transmitter double pulsing. Defective 327A in transmitter. Defective 5R4GY pulsing tube. Defective sweep tubes in indicator.
On second range dark circle observed out to 2 miles from center.	Corrected by adjusting linearity and calibration on second range.
Echoes suddenly disappeared from both scopes, although transmitter pulse and grass (controllable with gain) visible.	Checked receiver r-f tubes and found V–4002 defective. Replaced it and normal operation secured.
Extraneous spots on sweeps at center of tube.	Defective scope tube.
Inaccurate calibration.	Check for: Tube improperly centered. Adjustments of calibration controls not correct.
Enlarged sweep.	One high voltage rectifier defective.
Compressed sweep.	Defective low voltage rectifier.
Incorrect calibration.	Crystal oscillator not properly adjusted. Calibrate MAX and Calibrate MIN not properly set. Range pot out of adjustment. Defective Veeder counters.
No signals on screen.	Check for: Transmitter on. Sync timing switch on indicator in INTERNAL position. Duplexer-Receiver cable shorted or open. 1⅝" coaxial line to antenna open. Defective receiver tubes. Duplexer arcs shorted.

Receiver-Indicator—Continued

NATURE OF DIFFICULTY	TROUBLE FOUND AND REMEDY
Receiver sensitivity low.	Check for: Defective receiver tubes. High resistance connections in coaxial lines. High resistance grounds. Detuned receiver. Transmitter off frequency. Detuned duplexer.
No power.	Check for: Open interlock(s). Blown fuses. No power from control unit.
No sweep.	Check for: Defective 5BP7. Defective high voltage rectifier tubes. Defective high voltage filter capacitors. Defective tubes in sweep circuits. Second anode cap off the 5BP7. RADIATE switch in RADAR SILENCE position on control unit.
Jittery sweep.	Check for: Defective tubes in sweep circuits. Interference from other radars. Loose scope connections. Arcing in transmitter, duplexer, or coaxial line.
No range mark.	Check for: Defective V–704. Defective range pot.
Indicator not syncing.	Check for: Defective multivibrator. Sync output of transmitter low. Bad connection in junction box. Defective cable from transmitter sync source to receiver. Defective oscillator tube in transmitter. Transmitter plate voltage low.

Master PPI Unit

No power to PPI unit.	Check interlocks S–2002, S–2206 and S–2401 to see if they are closed. Check line fuses in oscilloscope section. Check interconnecting cables between indicator unit and oscilloscope section for power distribution.
No spot on cathode ray tube.	Check voltage at tube socket. Use extreme care since voltages in the order of 7000 volts are present here. Refer to instruction book for values. 2X2 rectifier tubes defective. Replace. High voltage transformer in power supply defective. Pyranol filter capacitors shorted in power supply. Accelerator anode off tube. Shut down equipment before attempting to replace connection. Extremely high voltages present. Defective 12BP7 C–R tube.
Scope shows bright spot but no trace.	Check tube V–2602 in the coupling unit to see if it is warm. If it is cold, check the connections in plug P–2604 for broken wires or replace V–2602. Turn on the transmitter and turn timing control NN of the receiver indicator unit to EXTERNAL. Check tube V–2402, type 807, in the sweep unit to see if it is making contact with all its socket connections and if plate cap is on the cap of the tube. Check circuit components and replace defective parts. Check all sweep tubes in sweep chassis. Check continuity of the sweep coils in the deflection yoke. If open, replace. Examine brushes on the yoke mechanism to see that they make connections with the contact rings.

Master PPI Unit—Continued

NATURE OF DIFFICULTY	TROUBLE FOUND AND REMEDY
	Check that contact rings are not shorted between the rings. Check continuity of synch cable from coupling unit to sweep chassis. P–2603 on coupling unit to P–2400 on sweep unit. Check that PPI tube is properly placed in yoke. The focus coil must be placed high on the tube neck. The tube neck flare should be within 1/16-inch of the top of the yoke. Check to see if the dummy loads (R–2033, R–2034, R–2035 or R–2036) are in place at J–2003, J–2002, J–2001, or J–2000 when the coaxial lines are not plugged in the above jacks. The jacks are found on the underside of the video unit. If the coaxial lines are plugged in the above jacks, check other end of the coaxial line to see if it is terminated either in the selector switch or a PPI repeater. The above two points are important.
Scope shows trace but will not focus properly.	Check R–2007 or R–2006 for an open or short. Check cathode follower tubes in video unit, V–2000, V–2001, V–2002 and V–2003 to determine if the tubes are functioning. Replace if defective. Check supply voltage. If voltage is low trouble will be encountered in focusing the sweep.
Scope brilliance too high even with BRILLIANCE control completely counter clockwise.	Check BRILLIANCE control. Check bleeder resistors R–2301 through R–2312 in high voltage power supply (oscilloscope unit) for any opens or changes in value. If the resistance increases considerably or any of the resistors open, there will be little control over brilliance. Replace defective resistors.
Sweep jumpy and erratic.	Check to see if condition is also apparent on "A" scope. If there, the trouble naturally is not in the PPI. Check the indicator unit. Check slip rings and brushes around yoke for sparking due to burns and dirt. Clean. Defective tubes in video section. Disconnect video coax and see if trouble persists. If it does, the trouble is in the sweep unit or its associated circuit. If trouble does not then appear, check video section and its associated circuit.
No "mark" on PPI tube.	Replace "mark" tube in cathode follower coupling unit in indicator. Be sure range switches on indicator and PPI are on the same range settings.
PPI will not calibrate correctly.	Clean between the contact rings on the rotating yoke assembly. Try replacing V–2402. Check V–2100. Replace if defective. Check with instruction book as to calibrating procedure.
PPI tube off center.	Recenter tube as per complete step-by-step instructions in the instruction book.

Master PPI Unit—Continued

NATURE OF DIFFICULTY	TROUBLE FOUND AND REMEDY
Trace does not rotate when "bug" in control unit rotates.	Check tubes in the servo amplifier chassis. If unit has been operating satisfactorily, then ceases to operate, replace 6L6 type tubes first, then driver tubes. Replace all tubes. *Do not attempt* making adjustments on servo amplifier controls until tubes have been placed and other possibilities checked. Check voltage across terminals TB88–5 to TB88–6. Should be approximately 115 volts. Check position of TRUE-RELATIVE switch on PPI. May be on TRUE without gyro excitation. Scope tube may be adjusted too far down so that it binds the deflection yoke. If so, readjust to clear yoke. Input to servo amplifier open. Check continuity of 5CT rotors.
Trace rotates "jerkily" or unevenly.	Scope tube may touch the deflection yoke, due to improper centering or vertical adjustment. If so, readjust according to instruction book. A defective tube in the servo amplifier can be responsible for such trouble. Replace with good tubes. Check that antenna is not also doing the same jumping. If it is, the trouble is not in the PPI unit. Check synchro circuit to servo amplifier for continuity, grounds, etc. After checking everything else, adjust servo amplifier controls as per instructions in instruction book.
Trace appears on scope but no video modulation.	Check "A" scope on inidcator unit for normal "grass." If not present ascertain that is the difficulty first. If normal check V–2600 (video tube of cathode follower). Replace if defective. Be sure P–2004 is tightly plugged into J–2004. Check all video tubes on video chassis V–2004, V–2006 and V–2007. Replace if defective. Check R–2025 (video gain control) to see if it is turned nearly all the way in a clockwise direction. Check V–2100 (type 5U4G) in low voltage power supply. Check continuity of coaxial cable between coupling unit and video chassis, P–2004 on video chassis, P–2601 on coupling unit. Check component values in video chassis for defective components. Replace if necessary.
Short sweep on scope tube.	Replace 807 type tube in sweep chassis. Check line voltage to see if voltage is at rated value. Check orientation of tube with deflection coil. Be sure tube is seated low in the yoke, the flare being not more than 1/16-inch from yoke top. Dirty contact rings on brushes on deflection coil. Clean space between rings periodically. If dirt, dust or metal deposit collects between the rings a low impedance path will be formed effectively short circuiting the rings and shortening the sweeps.

Master PPI Unit—Continued

NATURE OF DIFFICULTY	TROUBLE FOUND AND REMEDY
Sweep long enough at some bearings on the scope tube, short on others.	This is a common trouble experienced because the scope is not properly centered in the yoke. Be sure focus coil is high on the tube neck and the bell or flare of the tube not more than 1/16-inch from yoke top.
No power to PPI unit.	Check for: Open interlocks. Fuses blown (main or equipment). Interconnecting cables open.
No high voltage to MPPI tube (no spot).	Check for: Defective rectifier tubes. Defective power supply components, high voltage transformer or filter capacitors. Accelerating anode connection off tube. Defective tube.
Spot present on MPPI, no sweep.	Check for: Defective sweep and video tubes in coupling unit. Control switch positions on master unit indicator. Defective tubes in sweep chassis. Open deflection coil.
Short sweep.	Check for: Defective sweep amplifier tube. PPI tube not properly centered. High resistance contact to slip rings. Low line voltage.
Sweep too bright.	Check for: Open bleeder network in high voltage supply. Defective brilliance control.
Erratic sweep.	Check for: Dirty contacts at slip rings. Defective tubes in any of sweep or video chassis sockets.
No calibrating mark.	Check for: Defective mark amplifier in coupling unit. Defective coaxial cable from coupling unit.
Sweep on master was trailing the antenna by 20° to 30°.	This condition was corrected by adjusting R–1501 and R–1502.
Saturation level and height of echoes on the "A" scope would decrease when the MPPI was turned on.	This was found to be caused by R–2600 in the coupling unit which had changed value from its original value of 22,000 ohms.
Sweep on MPPI would not rotate with the antenna.	Found a brush on motor (B–2200) stuck in brush holder and making poor contact with the armature. Wiping the carbon dust off this brush eliminated this trouble.
Fuses blown.	Defective K–2200, T–2100, T–2101, T–2300, T–2301 or T–1506. Shorted C–2100 or C–2101. Check outgoing rotor circuit to remove PPI's shorted.
Scope trace does not point straight up and down with antenna on zero degrees relative.	Ascertain if the error is common for both TRUE and RELATIVE positions of the TRUE-RELATIVE switch. If so a correction may be made by re-zeroing the CT syncho in the oscilloscope section. Exercise extreme caution as high voltages are present. If the error is only in either true or relative correction must be made in that particular circuit in the antenna pedestal.
"Ghost" trace displaced from normal trace about 1¼-inch. Spots around center of tube (start of sweep).	Secondary emission. Replace scope tube.

Motor Generator

NATURE OF DIFFICULTY	TROUBLE FOUND AND REMEDY
Will not start.	Check for: Line fuses open. Magnetic controller contactors open. Defective push button station. Motor or wiring open. Excitation voltage too low.
Voltage low.	Check for: Motor speed low. Ships power low. Field rheostat setting high. Magnetic controller not cutting out completely.
Voltage high.	Check for: Motor speed high. Ships power high. Field rheostat setting low.
Brushes arcing.	Check for: Dirty contacts. Worn and/or dirty brushes. Correct angular setting of brushes. If necessary shift them in direction of rotation a few degrees.

TUBE TYPE 8014A OPERATION

The type 8014A tube is now available for use in the SD (or SD-a) transmitter. This new tube is a revised type 8014, redesigned for longer life. This change in design has necessitated a change in the operating characteristics of the filament. A comparison of the two tubes is as follows:

Tube	Fil. Voltage Volts	Fil. Current Amps.	Pri. Fil. Voltage Volts
8014	13.0	11.0	107
8014A	[1] 15.0	14.5	120.5
8014A	[2] 14.7	14.2	118.4

[1] For nominal life of 750 hours.
[2] For nominal life of 1000 hours.

In many cases the type 8014A tubes will be furnished as replacements for the type -8014 tubes now in service. When such replacements are received the following points should be carefully observed:

a. One 8014 and one 8014A cannot be operated as a pair in the transmitter unit due to the difference in filament operating characteristics, as shown in the above tabulation.

b. When two 8014A tubes are installed for the first time, set the "FILAMENT CONTROL" for a filament voltage of 14.7 volts this being the recommended value for a life expectancy of 1000 hours. This should be done by connecting a precision type a-c voltmeter, with a range not over 30 volts maximum directly across the filament leads of the tube (by lowering the corona shield). Adjust the "FILAMENT CONTROL" until the precision meter reads 14.7 volts. Log the reading of the "PRI. FIL. VOLTAGE" meter. Note that this reading given in the tabulation (118.4 volts) since the tabulated reading is a nominal value and does not take into account the accuracy of M-102. The reading as logged above may then be used for all type 8014A tubes which are subsequently used.

AGING 8014 AND 8014A TUBES

When new tubes are installed, they should be put through an "aging" process. The contractor recommends that RCA 8014 tubes, used in SD and SD-1 equipments, be aged by (1) applying filament voltage in the normal manner. Then (2) advance the transmitter plate control to a setting of 70 and let it run for at least three minutes. (3) Increase the voltage according to the following schedule:

Transmitter Plate Setting	Approx. Plate Voltage (KV)	Running Time (Minutes)
70	9.5	3
82	11	3
93	12.5	3
100	13.5	3
108	14.5	3
112	15	3

If arc-over occurs at any of these steps, the transmitter plate control should be backed off several points, and additional aging time allowed before proceeding to the next step.

A tube which consistently arcs at settings below 100 may be paired with another tube and operate satisfactorily at normal voltage. This should be tried with tubes having external grid-to-plate arcs. Normal voltage is 13.5 kv. The equipment is not rendered useless during this period of aging, since performance is still satisfactory (see "Transmitter Plate Setting" column).

TESTING 8014A TUBES

As 8014A tubes age in use, it is generally necessary to increase the value of grid leak to maintain stable pulsing. This type of instability is a resultant of all the changes that take place within the tube; that is changing emission, changing grid resistance, changing element spacing (due generally to filament distortion).

The type of instability due to bad cases of element distortion in 8014A tubes shows up as high transmitter plate current, or as unstable plate current associated with improper pulsing. In the latter case, when proper pulsing and steady plate current are obtained by grid leak adjustment, abnormally high plate current results. This trouble is a direct result of a low plate voltage to grid voltage cutoff ratio in one or both 8014A tubes. Means for testing tubes for this fault are outlined in "Cutoff Ratio Test Procedure in SD/SA Transmitters" below. In general tubes of equal cutoff ratios work best together.

In SA equipments, 8014A tubes with low cutoff ratios have been known to have stable plate current as much as twice the normal value, and still give satisfactory presentation on the receiver-indicator screen. However, ragged pulsing and unstable trace on the screen may result in some cases. In extreme cases, the presence of this trouble can be detected on the receiver-indicator screen by turning the CAL-SYNC switch to position No. 1 and the gain control to maximum. The transmitter pulse should then appear on one of the sweep ranges. (It is possible that some installations will not show a transmitter pulse on any of the three ranges with the CAL-SYNC switch or position no. 1. If this condition is found, reverse terminals 1 and 2 on transformer T-201 in the receiver.)

Method of Testing Old Tubes for Balance: CUTOFF RATIO E_P/E_G. One important figure of merit in an 8014A tube is the plate voltage to grid voltage cutoff ratio. In the SD/SA type of oscillating circuit, tubes with a ratio E_P/E_g equal to 20 to 24 will operate satisfactorily, other characteristics being correct. Ratios less than 20 may be considered of doubtful value. For the most stable transmitter operation, match two tubes of equal ratios together. By this means it is felt that old, discarded tubes may be paired together for several more hours of successful operation.

CUTOFF RATIO TEST PROCEDURE IN SD/SA TRANSMITTERS. a. Equipment required. Small "B" battery-45 or 67 1/2 volts, and a d-c voltmeter to measure

this "B" battery voltage. D-c voltmeter 1,000 or 1,500 volts full scale.

b. Remove 60-cycle locking voltage by removing the link of S-108 (locking voltage adjustment on transformer T-103).

c. Open the filament circuit of one tube by disconnecting one or both of its filament leads from their connectors inside the corona shield. NOTE: It is best to remove the corona shield to prevent shorting the filament circuit.

d. Connect "minus" of "B" battery to grid bars, "plus" to ground. Connect low voltmeter across battery.

e. Connect 1,000-1,500 d-c voltmeter from tube plate to ground.

f. With all power off, set plate current meter (M-101) accurately to zero by means of its zero adjustment. Set plate variac to zero. Turn on power and carefully bring up plate variac to give one (1) milliampere plate current indication.

g. Carefully read the plate voltage to give 1 milliampere (f above) and read the voltage of the grid battery.

h. Calculate E_p/E_g from information in g. This is the cutoff ratio of the tube which remained connected after operation c above. (A minimum satisfactory value is about 20, new tubes may measure a maximum of about 25.)

i. Repeat the procedure, after disconnecting the filament of tube just tested and reconnecting the other tube's filament.

Low Emission Test: A good method to check filament emission is to raise the filament transformers primary voltage by 3 or 4 volts. If the plate current increases appreciably (say over 10 percent, with proper keying maintained) the tubes (or tube) are emission limited.

INSTALLING TUBE TYPES 8014, 8103 AND 1960

The following steps should be carefully followed when installing the transmitter tubes:

a. Remove the four thumbscrews which secure the top mounting plates of the oscillator tube shelf and remove the plates.

b. Remove the thumbscrews and the corona shields which are secured to the filament leads below the filament-tune coils.

c. Loosen the screw which secures the left end of the grid line. Loosen the grid-cap clamps (knurled nuts, close to grid coils).

Technician's Checkoff Lists

The maintenance procedures outlined in the following checkoff lists were collected from data submitted by vessels, Navy Yards and manufacturers' radar field service engineers. These checkoff lists are to be used by the ship's radar technician or other radar personnel equally qualified. The checkoff lists should be made effective immediately upon receipt of this information. A copy of the checkoff lists (preferably typewritten) should be made for future use.

NOTE: After completion of each item check (√) in appropriate blank space.

Model SD, SDa, SD–2, and SD–4 Equipments

		Year___											
		Month_											
		Week__	1	2	3	4	1	2	3	4	1	2	3	4
ANTENNA, DIPLEXER AND TRANSMISSION LINES														
1. Check exterior of antenna for visual signs of damage. Inspect whips and locking screws.														
2. Check vertical alignment of mast and diplexer shoes.	S													
	M													
	T													
	W													
	T													
	F													
	S													
3. Check operation of limit switches.	S													
	M													
	T													
	W													
	T													
	F													
	S													
4. Check diplexer shoes for proper contact. Clean if necessary.	S													
	M													
	T													
	W													
	T													
	F													
	S													

Technician's Checkoff Lists—Continued

		Year											
		Month											
		Week	1	2	3	4	1	2	3	4	1	2	3	4
5. Check position of capacitor flaps.														
6. Inspect all units of hoist system.														
7. Check mast base seal.														
8. Check for moisture in antenna head or mast transmission line.														
9. Check coax for rigidity and tightness at joints.														
TRANSMITTER														
1. Check control transformer (T–104) for proper 8014–A filament voltage. Check control transformer lubrication. Ref: Instruction book and lubrication chart. Check action locking screw.	S													
	M													
	T													
	W													
	T													
	F													
	S													
2. Check for tight connections at 8014–A filaments and grids. Also antenna coupling straps, grid and filament tuning bars. Clean grid connectors with fine emery cloth if there are signs of oxidation.			X	X	X		X	X	X		X	X	X
			X	X	X		X	X	X		X	X	X
			X	X	X		X	X	X		X	X	X
3. Check for proper seating of 8014–A tubes in sockets and tighten anode clamp plates.			X	X	X		X	X	X		X	X	X
			X	X	X		X	X	X		X	X	X
4. Check and tighten all terminal board connections.			X	X	X		X	X	X		X	X	X
5. Check blower motor operation and lubrication. Ref: Instruction book and lubrication chart.			X		X		X		X		X		X
			X		X		X		X		X		X
6. Check for proper operation door interlocks and high-voltage shorting bar.			X	X	X		X	X	X		X	X	X
7. Check plate current (M–101) for normal reading and stable operation.	S													
	M													
	T													
	W													
	T													
	F													
	S													

Technician's Checkoff Lists—Continued

		Year											
		Month											
		Week	1	2	3	4	1	2	3	4	1	2	3	4
8. Check for glow in 1960 duplexer tube.	S												
	M												
	T												
	W												
	T												
	F												
	S												
9. If stable targets are available, check for peak duplexer.													
10. Using a stable land target, check for peak 8014–A filament tuning bar setting.													
11. Check operation, clean contacts time delay relay, K–102.			X	X	X		X	X	X		X	X	X
12. Thoroughly clean all dirt and foreign material from interior of transmitter, especially blower and T–102, C–102.			X X	X X	X X		X X	X X	X X		X X	X X	X X
13. Inspect for signs of salt water damage or corrosion. Clean if necessary.			X	X	X		X	X	X		X	X	X
RECEIVER-INDICATOR													
1. Check and tighten all control knob set screws and shaft couplings.			X	X	X		X	X	X		X	X	X
2. Check and tighten all cable connectors.			X	X	X		X	X	X		X	X	X
3. Check all controls for proper operation.													
4. Check for good connection on all scope (V–217) connector caps.			X	X	X		X	X	X		X	X	X
5. Check operation of all r-f, i-f, and video tubes by replacing one at a time and observing comparative results on fixed land target.			X X	X X	X X		X X	X X	X X		X X	X X	X X
6. Thoroughly clean all dirt and foreign material from interior.			X	X	X		X	X	X		X	X	X
7. Check receiver tuning using OAO or land echoes if available.	S												
	M												
	T												
	W												
	T												
	F												
	S												

Technician's Checkoff Lists—Continued

		Year											
		Month											
		Week	1	2	3	4	1	2	3	4	1	2	3	4
8. Check markers at recommended setting of plate voltage control transformer.	S												
	M												
	T												
	W												
	T												
	F												
	S												
9. Check tubes for tightness in sockets.													
GENERAL													
1. Check entire system for visible or audible r-f arcing.			X	X	X		X	X	X		X	X	X
2. Check all ground straps, mounting brackets, shock mounts.													
3. Check Field Change Record.													
4. Person checking equipment should initial and date.	Initial												
	Date												

NOTE: Lower mast sufficiently to disengage shoes, and using a megohmmeter, make resistance tests between conductors of mast transmission lines and from each conductor to mast. This test should be made only when outside surface of antenna head is dry. The leakage resistance of a clean, dry system will be at least 50 megohms.

Technician's Checkoff Lists—Continued

		Year___											
		Month_											
		Week__	1	2	3	4	1	2	3	4	1	2	3	4
ANTENNA AND TRANSMISSION LINE														
1. Check exterior of antenna for visual signs of damage. Inspect whips and locking screws.														
2. Check air pressure in transmission line.	S													
	M													
	T													
	W													
	T													
	F													
	S													
3. Check condition of dehydrator indicating crystals and dehydrating chamber.	S													
	M													
	T													
	W													
	T													
	F													
	S													
4. Check coax for rigidity and tightness of joints.														
TRANSMITTER														
1. Check output voltage of M–G set and regulate to obtain recommended voltage on the transmitter filament primary meter.	S													
	M													
	T													
	W													
	T													
	F													
	S													

Technician's Checkoff Lists—Continued

		Year___											
		Month_											
		Week__	1	2	3	4	1	2	3	4	1	2	3	4
2. Check for tight connections at 8014–A filaments and grids.				X	X	X		X	X	X		X	X	X
3. Check and tighten all terminal board connections.				X	X	X		X	X	X		X	X	X
4. Check blower motor operation and lubrication. Ref.: Instruction book and lubrication chart.				X		X		X		X		X		X
5. Check for proper operation door interlocks and high-voltage shorting bar.				X	X	X		X	X	X		X	X	X
6. Check plate current (M–101) for normal reading and stable operation.	S													
	M													
	T													
	W													
	T													
	F													
	S													
7. Check for glow in 1960 duplexer tube.	S													
	M													
	T													
	W													
	T													
	F													
	S													
8. If stable targets are available, check for peak duplexer tuning.														
9. Using stable land target, check for peak 8014–A filament tuning bar setting.														
10. Check operation, clean contacts time delay relay, K–101.				X	X	X		X	X	X		X	X	X
11. Thoroughly clean all dirt and foreign material from interior of transmitter, especially blower and T–102, C–102.				X	X	X		X	X	X		X	X	X
12. Inspect for signs of salt water damage or corrosion. Clean if necessary.				X	X	X		X	X	X		X	X	X

Technician's Checkoff Lists—Continued

		Year___											
		Month_											
		Week__	1	2	3	4	1	2	3	4	1	2	3	4
RECEIVER-INDICATOR														
1. Check and tighten all control knob set screws and shaft couplings.				X	X	X		X	X	X		X	X	X
2. Check and tighten all cable connectors.				X	X	X		X	X	X		X	X	X
3. Check all controls for proper operation.														
4. Check for good connection on all scope (V–217) connector caps.				X	X	X		X	X	X		X	X	X
5. Check operation of all r-f, i-f, and video tubes by replacing one at a time and observing comparative results on fixed land targets.				X X	X X	X X		X X	X X	X X		X X	X X	X X
6. Check tubes for tightness in sockets.														
7. Check receiver tuning using OAO or land echoes if available.	S													
	M													
	T													
	W													
	T													
	F													
	S													
8. Check markers at recommended setting of plate voltage control transformer.	S													
	M													
	T													
	W													
	T													
	F													
	S													
9. Thoroughly clean all dirt and foreign material from interior.				X	X	X		X	X	X		X	X	X
GENERAL														
1. Check all ground straps, mounting brackets, shock mounts. 2. Check Field Change Record. 3. Person checking equipment should initial and date.	Date Initial													

LUBRICATION CHART (SD SERIES)

Proper maintenance requires periodic lubrication of the various components. This chart is intended to reference the units involved, time serviced, and to give the Navy type number if available. Reference must also be made to the instruction book for location of lubrication points and the quantity of lubricant required.

Equipment			Service					Lubrication date						
Unit involved	Name of component	Circuit symbol	Hours	Daily	Weekly	Monthly	Annual	Oil	Grease	Instruction book type	Commercial type	Navy type	Nearest Navy equivalent	Comments
SD/SDa transmitter	Blower motor	B-101	200					X		Light oil	SAE #20	3050 or 9170		See Note 2.
SD-1 transmitter	Blower motor	B-101	200					X		Light oil	SAE #20	3050 or 9170		See Note 2.
SD-2 transmitter	Blower motor	B-101	200					X		Light oil	SAE #20	3050 or 9170		See Note 2.
SD-3 transmitter	Blower motor	B-101	200					X		Light oil	SAE #20	3050 or 9170		See Note 2.
Train indicator	Ratiomotor	B-301				X			X	Socony Vacuum Gargoyle No. 1.	Semifluid grease		14L3 Grade II	Plug fitting. See instruction book.
	Dial and control gears					X			X	Socony Vacuum Gargoyle No. 1.	Semifluid grease		14L3 Grade II	
	Dial and shaft bearings					X		X		Navy 2250 or 3065 Univis No. 60.	SAE #30	3065 or 9250		
	Ratio gears				X			X		Navy #5190 or 6135—#600W oil.	600W	5190 or 6135		See Note 1.
	Ratio gears						S	X		Navy #5190 or 6135 #600W oil.	600W	5190 or 6135		See Note 1.
	Cam on train selector shaft					X			X	Petrolatum	Petrolatum		14P1	
Antenna pedestal and linkages.	Gears						S		X	Beacon M-285	Soft gear grease	O. S. 1350		
	Spline coupling						S		X	Beacon M-285	Soft gear grease	O. S. 1350		
SD-4 and SD-5 transmitter.	Blower motor	B-101						X		Navy 3050 SAE #20	SAE #20	3050 or 9170		See Note 2.

S=Semiannually. Q=Quarterly.

d. Place the oscillator tubes (V-101, V-102) carefully in the socket holes of the tube shelf, grid ends down, at the same time guiding the grid clamp with one hand as the tube is inserted, so that the grid cap fits into the clamps without strain on the grid cap.

e. Replace the top plates and secure them with thumbscrews.

f. Carefully tighten the grid-cap clamps using only finger pressure. Carefully tighten the grid line retaining screw at the other end. NOTE: The grid line must be horizontal and must not place any strain on the grid caps of the tubes.

g. Carefully place the corona shields over the filament straps of the tube, making certain that the filament straps lie each on opposite sides of the insulating separations which are inside the shields. (WARNING: Tube filament straps and the leads to which they attach are very small and must be handled carefully.)

h. Loosen the setscrews in the ends of the filament leads and very carefully slip clamps over the tube filament straps. Tighten the setscrews.

i. Replace the corona shields carefully, being sure not to twist them. Grid to filament short is a common cause of failure of the 8014, caused by twisting or otherwise straining the grid terminal. Such mishandling is indicated when the copper seal appears crinkled or wavy.

j. The rectifier tube, (V-103) type 8013, should be inserted in its socket which is located on top of the plate transformer. The plate lead should be placed over the cap on top of the tube. This tube is held in its socket by a clamp around the base. The clamp is released by loosening screw reached through the hole in side of socket shield. The tube may then be withdrawn by pulling up.

k. The three setscrews at the base of the duplexing unit which is located in the rear left corner of the transmitter cabinet, should be removed.

l. The type 1960 gas tube (V-104) should be carefully inserted in the base of the duplexing unit. This tube should never be forced into place.

m. Line up the slots in the tube flange with the tapped holes in the duplexing unit, and insert the screws. When it has been determined that the alignment is correct, carefully tighten the screws.

TUNING THE SD RADAR SYSTEM

The following information should prove helpful in tuning up the SD radar system. When the OAO wavemeter is used it will supersede this data.

Transmitter Tuning: Check the transmitter tuning while in port before each patrol. Do not change the transmitter tuning unless a wavemeter is available.

Within the rated tuning range of the transmitter there is usually a band of frequencies two or three megacycles wide to which the transmitter cannot be made to tune. This band is called a skip band and if an SD transmitter is tuned too near to either side of this skip band it will often transmit on two different r-f frequencies. Also, if left in this condition the transmitter frequency may shift from one side of the skip band to the other as the transmitter tubes age. If this happens while on patrol, operation may still appear to be normal even though no echoes can be received. This has happened and the results were nearly disastrous. This trouble must be avoided by making the following check while in port where a wavemeter is available.

a. Shift the transmitter grid tuning bar two marks (four numbers) above its usual setting.

b. Measure the transmitter frequency.

c. Shift the grid bar two marks below its usual setting.

d. Again check the frequency.

Over this range of four marks (eight numbers) the frequency should not shift by more than one megacycle. If it shifts more than this the transmitter is tuned too near to one edge of a skip band. Move the grid tuning bar in the proper direction to achieve this stability if it is lacking. This check before leaving port is excellent insurance against unstable transmitter operation and should be done before every patrol.

Receiver Tuning: The SD receiver can be tuned accurately and with complete certainty even though no echoes are available. The following method is not recommended for use where echoes are available but in a pinch when far at sea, it is a reliable procedure.

Peak the local oscillator in the receivver as follows:

a. Turn the sensitivity control down until the transmitted pulse or "flag" as seen at the left end of the indicator trace is only an inch high. (NOTE: On SD-2 equipments the intensity control must be turned up high before this can be seen.) When the sensitivity has been reduced to this low level, the receiver oscillator can then be set.

b. Adjust the oscillator knob until the left hand edge of the flag is as high as possible. On most receivers there are four points in one complete turn of this knob where the transmitted flag rises. If there are four, then any one of these will work equally well. If there are more than four; it is a sign that the transmitter is transmitting on two different r-f frequencies. (This means bad trouble. See "Transmitter Tuning" above.) Some systems have only two points in one whole turn of the oscillator knob where the transmitted flag can be made to peak. In this case, either one is satisfactory. Also, some systems have three points where the oscillator can be made to peak and if this situation exists, BEWARE for one of these three points is a fake point and receiver is not correctly tuned when you set the knob there. If the oscillator knob is correctly positioned on its shaft, one of the three peaks will occur when the arrow on the knob points straight left or right (horizontal). In this case the plates of the oscillator tuning condenser are either tuned all of the way out or all of the way in and correct tuning is then impossible. Use one of the other two positions in this case. After the receiver oscillator has been set, the r-f stages can be tuned.

Tune the r-f stages as follows:

a. Turn the sensitivity control all of the way on.

b. Start with the tuning slug in the r-f coil nearest to the front of the chassis (L-207). Turn it 3 or 4 turns in either direction and watch the height of the transmitted flag. These r-f stages tune quite broadly but when they are correctly tuned, the additional r-f gain causes the whole trace to drop lower on the face of the indicator tube. This is best noted by looking only at the position of the trans-

mitted flag and ignoring the grass along the rest of the trace. This drop in the whole trace when the r-f slugs are brought in tune is just like the way that the trace drops when the receiver sensitively control is turned from any low value to full on. Check this tuning procedure while you are in port and you'll always know what to look for. After L-207 has been set, tune L-205 and L-203 in the same way. The receiver antenna coil tunes even more broadly than the others and sometimes cannot be made to peak at all, even though the equipment is operating satisfactorily. Better leave this alone and adjust it only when echoes are available.

I-F ALIGNMENT. NOTE: Do not change the tuning of the I-F transformers. The i-f transformers in the SD system are of the double tuned type and can be adjusted accurately only with a television-type wide-band sweep generator. These transformers rarely require tuning. The RCA field engineers have a suitable sweep generator if this is ever required. Among 40 receivers checked at Midway last summer, there was only one where i-f alignment has really required and this was necessitated by an uninitiated technician's attempt to peak these stages.

SD TYPE SYSTEMS WITH U ANTENNAS

It has been found that transmitters cannot be tuned to certain frequencies when used with the U-type antenna. These "skip" frequencies may occur anywhere, but generally they occur near the middle of the band to which you want to tune, and may be a megacycle or so in band width. Where the "skip" occurs depends on length of transmission line, diplexers' setting and nature of the antenna.

When the transmitter is tuned near one of these "skip" bands, it will operate on two frequencies, may be unstable and generally results in weak received signals.

It is suggested that a curve be plotted to determine these "skip" frequencies as follows, with the whips you intend to use (see fig. 1):

a. Set up system roughly for best operation.

b. Holding all settings the same, take successive frequency readings by moving the grid bar, in steps of 1 megacycle, over a range of nominal frequency minus 5 to nominal plus 6.

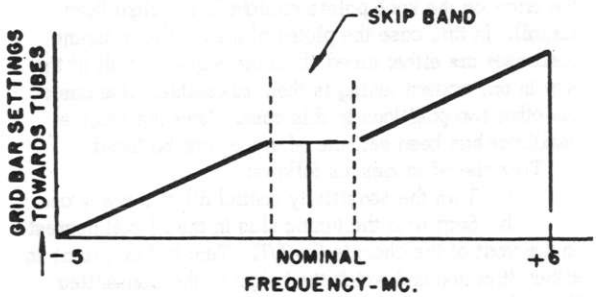


FIGURE 1.—Plotted curve showing skip band.

c. The transmitter frequency should not be left nearer than 1 megacycle of the "skip" band.

SKIP BAND WITH SD-3 TYPE ANTENNA

The frequency spectrum of the SD type transmitter feeding an SD-3 type antenna may have two or more "skip" bands. This condition varies with the length of transmission line.

With one setting of the antenna coupling, filament tuning, grid locking voltage, etc., vary the grid tuning bar as outlined below. Plot grid setting vs. frequency. You may obtain a curve similar to figure 1.

a. Set up system roughly for best operation.

b. Holding all settings the same, take successive frequency readings by moving the grid bar, in steps of 1 megacycle, over a range of nominal frequency minus 5 to nominal plus 6.

c. The transmitter frequency should not be left nearer than 1 megacycle of the "skip" band.

By means of the OT measuring line, determine the frequency that gives the best standing wave ratio in the ranges where the frequencies are continuous. Do not set the transmitter near one of the "skip" ranges. The SD-3 antenna is tuned for the nominal frequency but will give a good field pattern in a band width plus or minus 3 mc/s of the nominal frequency.

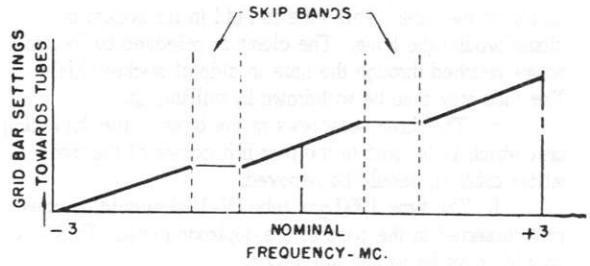


FIGURE 1.—Plotted curve showing skip bands.

TRANSMITTER SERVICE NOTES

Oscillation at Two Frequencies: Field reports indicate that the transmitter may oscillate on two frequencies about 2 mc/s apart, especially when attempt is made to operate at the optimum frequency of the antenna. In using 758A General Radio wavemeter to check for dual frequency, couple wavemeter loosely enough so that its condenser does not spark over.

It has been found that the following will cause the transmitter to operate on a single frequency.

a. Decrease plate voltage (not recommended because it reduces power output).

b. Decrease antenna coupling.

c. Decrease locking voltage (produces tendency to random pulse).

d. Detune slightly until single frequency operation is obtained.

Normal plate current is about 17 milliamperes when transmitter is operating on two frequencies.

Normal plate current is about 12 milliamperes when transmitter is operating on one frequency.

Operation on two frequencies is indicated, when on changing the receiver oscillator condenser setting slightly, two side by side images appear.

Filament Tank Flashover: Improper loading of the transmitter by the antenna and transmission line will cause excessively high voltages to appear across the filament tank, causing it to flash over.

Such improper loading may result from:

a. Broken antenna or stub.

b. Broken antenna insulation.

c. Water splashing against antenna when it is awash.

d. Water accumulating in the transmission line.

e. Open or shorted transmission line.

Pulse Rate Adjustment: When used on a 60-cycle supply, the transmitter pulse rate should be 60 cycles.

After the transmitter is properly tuned and loaded, the pulse rate will be determined by the oscillator grid circuit time constant and the magnitude and frequency of the locking voltage used.

Remove locking voltage by disconnecting primary of T-103.

Operate transmitter and listen to pulse rate as received on an auxiliary receiver. The self pulse rate should be less than 60 cycles and preferably about 40 cycles.

Shut off transmitter and adjust link switch S-103 until self pulse rate is about 40 cycles. If a rate as high as this cannot be obtained using the installed resistors, adjust S-103 to obtain the highest pulse rate.

Apply somewhat more than the minimum locking voltage required to effect synchronization at 60 cycles.

Multiple traces on indicator screen indicates synchronization at more than 60 cycles. If trace drifts, the pulses are not synchronized.

FIELD ADJUSTMENT OF RECEIVER-INDICATOR TYPE CRV-46ABA

Presented here is a list of adjustments on the SA/SA-1 Receiver Indicator, Navy Type CRV-46ABA, which should not be touched in the field except in some few cases where new parts are installed or where unauthorized adjustments have already been made.

I-F Transformer Adjustments: These adjustments should never be touched after the equipment has left the factory except when a new transformer is installed or when all other methods fail to bring the receiver back to normal sensitivity. In this case, adjust only the affected transformer. Do not touch the remaining adjustments. The effect of a misadjustment of any one transformer is not particularly noticeable in the performance of the receiver. It is possible however by misadjustment of several of the transformers to seriously impair both the sensitivity and signal to noise ratio.

a. If any receiver exhibits low sensitivity it is probably due to old tubes with low mutual conductance. All tubes should be replaced every 1,000 hours.

Range Calibration Adjustments: There are three range calibration adjustments inside the deflection amplifier. These should never be touched unless a calibration potentiometer is replaced. In this case adjust only the replaced unit.

a. The effect of slight misadjustment of any of these potentiometers is simply a reduction in the accuracy of calibration on the 75-and 375-mile scale. A considerable misadjustment, however may seriously affect the ability of the receiver to synchronize properly on the transmitter pulse.

Calibration Amplitude Adjustment: This adjustment is inside the deflection amplifier and should never be touched unless the potentiometer is replaced. Slight misadjustment of this control has no effect on the calibration accuracy. A large misadjustment may cause the receiver to synchronize poorly on the transmitter pulse.

Heater Thermostat: The adjustment on this thermostat should never be touched under any conditions. This adjustment does not vary the temperature at which the thermostat operates. Its only function is to determine the correct contact pressure for firm and reliable closure. This adjustment has been sealed at the factory where accurate equipment is available for measuring contact pressure.

Leeds and Northrup Ranging Potentiometer: No adjustments should be made on this unit in the field. It is permissible, however, to replace the sliding contact spring if the one on the unit shows signs of wear or reduced spring pressure. Under no conditions should the contact pressure be adjusted by bending the spring. This adjustment has been made at the factory where accurate gages are available for measuring contact pressure. Excessive contact pressure may cause the resistance wire to wear unevenly and reduce the accuracy and life of the unit.

Please bring out these precautions as part of the regular instruction to Navy personnel. These instructions are also to be applied to the receivers in the SD, SD-a, SD-1 and SD-3 type equipment.

SLOTTING OSCILLATOR TUNING CONTROL SHAFT

The Bureau has received several reports that vessels have found it advantageous to remove the knob on the shaft of the oscillator tuning control (C-218), saw off the shaft at the panel and slot it for screwdriver adjustment. This will prevent accidental detuning of the oscillator.

The knob should be placed in the equipment maintenance parts box.

The Bureau authorizes this change which is within the scope of the forces afloat and should be accomplished if found necessary.

CG-50ADH PREAMPLIFIERS

The Bureau has received reports from the field indicating numerous failures of Preamplifier Type CG-50ADH. The failure of the preamplifier is often difficult to detect by merely observing the amount of grass on the indicator screen. A test of the operation of the preamplifier may be made as outlined below:

a. Where suitable land targets are available, a comparison may be made of the echo height of a stable target with the preamplifier in the circuit, and the echo height of the same target with the preamplifier bypassed. The preamplifier when working properly should increase echo height considerably.

b. In the absence of satisfactory land targets, the OAO frequency meter equipment may be used as a source of echo indication.

In the event that ready means of by-passing the preamplifier have not already been provided, the Bureau recommends that the necessary changes be made at the first available opportunity.

The most prevalent troubles experienced with the CG-50ADH are as follows:

a. Defective 446A tubes.

b. Defective plate capacitors.

A full complement of spare type 446A tubes should be maintained at all times. In order to insure that spare tubes stocks do not contain defective or substandard tubes, these tubes should be pretested.

Defective plate capacitors generally are indicated by low or intermittent amplifier gain and loss of normal plate voltage at the tube. Replacement of these capacitors may best be made by replacement of the entire plate connector assemblies. These assemblies are available in equipment spare parts.

In all cases where performance of the preamplifier is questionable, it should be by-passed and the radar equipment operated without it until such time that it can be restored to a satisfactory operating condition.

RECEIVER SERVICING NOTES

Several suggestions have been made to facilitate the installation, adjustment and servicing of SD type equipment. To combine the information in one place, these suggestions are summarized:

Oscillator Coil: It has been found that the sensitivity of some receivers has been improved by reversing oscillator coil L-208. Procedure: Remove oscillator coil. Pull wire out straight and rewind in the opposite direction. Move tab to side closest to cathode connection on V-205, adjusting spacing (by bending) between oscillator coil and detection coil for maximum performance. Performance can be determined by noting tube noise.

Internal Temperature: In high ambient temperatures, the temperature within the receiver chassis becomes too high. In some cases it has caused the transformers to leak oil. To give temporary relief until detailed instructions for ventilation can be given, it is suggested that the receiver cover be raised and blocked open to give better ventilation. The bakelite interlock contactor plug will have to be moved and inserted in the cover switch to permit operation.

R-F Tuning Plugs: These plugs sometimes short the coil turns due to the close clearance between coil and plug. Scotch tape has been placed around the plugs as a remedy for this difficulty; however, a better method is to dip the plugs twice in polystyrene cement.

9001 Receiver tubes: It has been found that 9001 tubes which would not operate properly in the first r-f stage would operate properly in other positions. Therefore, it is suggested that the 9001's be changed around to find the best location for them.

One or more of these tubes may fail during preliminary adjustment of the equipment after installation. Failure is usually caused by high frequency energy feeding back into the receiver before the duplexer is adjusted.

Rapid, repeated failure of first r-f 9001 tube indicates that either the duplexer is mistuned or that the gas tube is inoperative or defective.

High Sensitivity Effect: The effect of high sensivity (or high grass) all across the indicator signal, may be caused by anoisy 6H6 tube, and not be an indication of high sensitivity.

Intermittent Contact in Tube Sockets: Miniature tube sockets are constructed of a material which softens or melts under the heat of prolonged soldering. The contacts may then become misaligned because of wiring strains and softening. Intermittent and poor contact will then be experienced. Remedy is to carefully bend the contacts into proper place or replace socket.

Receiver Ground Connections: In old type SE receivers, the r-f coil grounds were made to fittings riveted to the chassis. These rivets frequently make poor contact with the chassis, thereby causing low sensitivity or instability. It is recommended that in all the old type SD receivers, the rivets be aluminum soldered to the chassis on top side.

Antenna Stage Tuning: If the antenna coil will peak when the receiver is being aligned on a signal generator (used with dummy antenna) but cannot be peaked at the same frequency when connected to the system antenna, a mistuned duplexer is indicated.

POWER-PULSE CABLE REPLACEMENT

The power-pulse cable (RCA drawing No. M-422723) between the SD transmitter and receiver-indicator is no longer available. In the event that this power supply cable assembly fails, the following method of repair can be used.

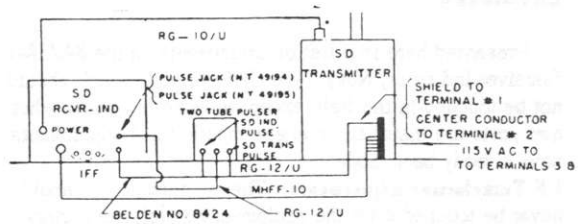


FIGURE 1.—Connections when 2-tube pulser is used with SD.

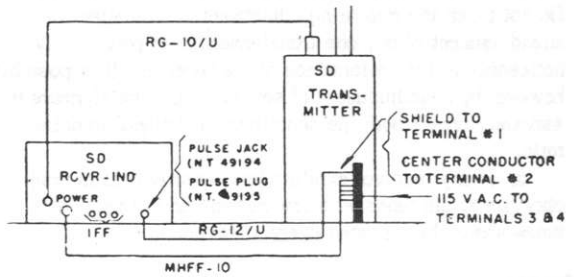


FIGURE 2.—Connections when SD is used without pulser.

Two cables are used instead of one. Coaxial cable RG-12/U and power cable MCOS-10 are connected as shown in figures 1 and 2. A pulse jack (Navy type 49194) is added to the receiver and a pulse plug (Navy type 49195) is used on the coax. The present power plug and jack can be reused.

Figure 1 shows the connections when a two-tube pulser is used in conjunction with the SD radar. Figure 2 shows the connections when the SD radar is used without the pulser or if the one-tube pulser (built in the SD receiver-indicator) is used. (See Field Change 12-SD.)

R-108, R-242 RESISTOR TROUBLES

Several service reports indicate that ships reporting difficulty with their SD equipment are often found to have trouble in both the transmitter and receiver of the SD equipment. The common fault has been a defective 4-ohm resistor (RR-108) in the transmitter and/or a defective 100-ohm resistor (R-242) in the receiver.

The failure of these resistors was thought due to the arcing of the 8014-A transmitter tube; however, tests show that the 4-ohm resistor will not fail under extended conditions of tube arcing. The extremely short duration of the pulses caused by the arcing limits the average current, and hence the average dissipation to a nominal value. Furthermore, a steady state plate current of high value which might be caused by the transmitter's not oscillating, in general would not cause the 4-ohm resistor to fail. A value of plate current equal to 0.7 ampere could exist and still not exceed the power rating of the 4-ohm resistor. The protective circuit breaker would open under normal conditions at a point much lower than 0.7 ampere and thus give protection to the 4-ohm resistor.

When the 4-ohm resistor opens up, the full transmitter plate voltage is placed on the pulse coax which overloads and overheats the 100-ohm resistor in the receiver unit which causes it to open up. The equipment, when found in this state, may have the image on the CR tube displaced over to the right, or the equipment may double pulse either of which makes the equipment practically unusable. It is, therefore, important that if either resistor is found defective, to check the other one.

In view of the above, it must be concluded that failure of the 4-ohm and 100-ohm resistors is caused not be excessive arcing of the transmitter tubes but by carelessness when installing new or spare 8014-A tubes. During this process, the filament clamp may be shorted to ground (outside of coil) or to the corona shield. This places one-half the filament voltage across the 2-watt 4-ohm resistor and results in almost immediate failure. It is suggested that the following points be carefully observed during the installation of 8014-A tubes:

a. Install tubes exactly as directed on 8014-A "Installation Instructions."

b. Inspect corona shield and be certain that the inside fiber lining and partition is intact and correctly located.

c. Upon installing be sure that the filament connectors are on opposite sides of the partition. The corona shield should slip up easily without forcing.

d. When new tubes are installed for the first time never throw the filament switch on with the variac set for full filament voltage. Always set variac at zero voltage and bring up slowly at the same time observing filaments through the blower hole. If one tube fails to light at 1/4 to 1/3 normal variac setting or if one tube is definitely brighter than the other, shut down immediately and investigate connections inside the corona shield.

When it is necessary to replace either the 4-ohm or 100-ohm resistors in the field, it should be done with units which are noninductive or which have low inductance.

MISCELLANEOUS SERVICE NOTES

Astigmatism: Trace in focus over only part of screen. Can be remedied by varying 2d anode voltage plus/minus 100 volts.

Fuzziness: Trace in focus vertically and out of focus horizontally is due to insufficient filtering. This condition is being remedied by installing additional filter in new receivers and by modifying installed receivers by addition of a similar filter.

Marker Frequency Incorrect: Reproduction at a multiple rate of normal can be stopped by grounding receiver antenna cable at point where it passes through bulkhead.

Reproduction at other than normal rate (except multiples) readjust C-251.0. (See instructions.)

Double Tracing: Is caused by water splashing against antenna when it is just awash. At times the transmitter may kick off because of poor loading for the same reason. Remedy is to get antenna higher above water surface.

Is caused by transmitter pulsing at 120 cycles or more. Remedy is to increase time constant of osc. grid circuits or to decrease locking voltage.

Base Line not Centered on Screen: When not caused by troubles within the receiver is usually caused by a steady magnetic field from nearby d-c wiring or permanent magnets.

Mast Switch Insulator Breakage: When the ship's battery voltage is greater than 250, the mast will overshoot and cause insulator breakage.

Practical remedy is to slot the mast where the insulators strike, to allow overshoot without damage.

MODEL SD SERIES TROUBLESHOOTING NOTES

Antenna

NATURE OF OPERATION	TROUBLE FOUND AND REMEDY
Intermittent interference causing sharp flashes to appear on the screen.	A resistance measurement was taken of the antenna system and it was found to be about 20,000 ohms. The antenna was removed and the insulators were cleaned and the impedance matching transformers in the feeder line were soldered to the feed line per advice of RCA Field Engineer. Cleaning the insulators increased the leakage resistance to approximately infinity and caused some decrease in the interference previously mentioned.
Resistance between mast transmission line and ground 10,000 ohms.	Removed antenna and transmission from mast. Found moisture on insulators and some corrosion spots along first section of line from top. Cleaned and dried all of line, interior of mast, and connectors.
Low sensitivity. Poor signal to noise ratio.	Removed antenna and feeders. Cleaned insulators and installed improved type solid connectors. Retuned equipment to optimum frequency.
Unstable sweep.	Made sure that whenever the antenna mast was raised the shoes stopped at the same place.
Low sensitivity. Poor signal to noise ratio.	Removed antenna and feeders. Cleaned insulators and installed improved type solid connectors. Retuned equipment to optimum frequency.

Transmitter

"Double trace" on indicator screen.	Transmitter was found to be tuned about 4 megacycles lower than normal operating frequency.
The interlock switch in the transmitter did not make contact.	It was found that there were insufficient spacers behind the switch. An additional spacer was made, after which the switch made proper contact.
Some tendency towards instability at high plate voltages.	Transmitter would become unstable at 12 kv. Plate current reading 8 ma. at 12 kv. Increased locking voltages from Tap No. 1 to Tap No. 3, thus obtaining stable operation of the transmitter over the range from 6 kv. to 14 kv. Decided that the plate current of 8 ma. at 12 kv. was not abnormal, and made no attempt to increase the loading, since the results were noted to be good with this plate loading.
Double pulsing and instability of plate current noted after set had been in operation for approximately 3 hours.	Increasing grid resistance of 8014–A oscillator tubes corrected this trouble.
It appeared impossible to obtain a transmitter and diplexer setting that would stop the persistent double pulsing.	The bottom of the antenna mast was dismantled, and the ⅝-inch conductors were rotated to determine if shorting of these conductors was causing the trouble. Nothing was found but in the process temporary jumpers were used to reconnect the transmission line to the diplexer. Miraculously the diplexer exhibited control, and the transmitter could be stabilized. It was analyzed that capacity across the output of the diplexer could simulate the same condition. Mast end, and shoes were reassembled, and an air dielectric capacitor of approximately 15 to 20 $\mu\mu$f was mounted on the output bus leads. This proved that on this particular short mast the diplexer supplied didn't have sufficient range to adjust the system.

Transmitter—Continued

NATURE OF OPERATION	TROUBLE FOUND AND REMEDY
Lost all power on transmitter and receiver indicator.	Found loose interlock in the receiver indicator lid. Spread the prongs and operation OK.
Low sensitivity.	Found the retaining spring missing from the second r-f tuning slug. This allowed vibration to slowly detune it. As a temporary cure the stage was properly peaked and the slug then secured with a drop or coil dope. Operation of the equipment was then satisfactory.
Intermittent cutting out of high voltage to transmitter.	Check revealed that fuse F–101 in transmitter high voltage was overheating and would open up intermittently. Replacing fuse corrected trouble.
Transmitter was putting out energy on two frequencies.	It had been tuned too near a "skip" frequency. Retuned.
8014A tubes, tube mounting plates and grid coils were burned black.	Blower motor air vent in door of SD transmitter was blocked by supplies.
Transmitter unstable; double trace on screen.	Retuned transmitter to the nominal frequency; tried various grid lead values and locking voltages. This resulted in a more stable condition; however, when the 3-inch coaxial line was jarred, the transmitter became unstable, and the echo height was reduced intermittently. Opened the 3-inch coaxial line at one of the elbows, and found that the inner conductor was broken loose at one of the joints. Repaired the loose connection described above, and then retuned the entire system. Final results were stable operation of the transmitter and good echo strength.
Trace started double and triple pulsing along with high grass.	Had to replace both 8014A's before trouble cleared up.
Neither the plate current meter on the receiver or on the transmitter would give any indication, although the transmitter was drawing current. Also, a double trace appeared on the s reen.	It was found that the negative end of transformer T–102B secondary was shorted to ground, thereby short circuiting resistors R–106 and R–107, thus no voltage appeared across the plate current meters. The ground was then traced to the lead-sheathed wire, which runs between terminal No. 1 on the transformer T–103B and the terminal board No. 3B. Replaced the wire and cleared the trouble.
Flashes appeared on the screen; also the sweep would move up and down.	This was caused by the a-c voltmeter in the transmitter becoming partially shorted. Repairing the meter brought back normal operation.
Trace jumped back to the right of the screen intermittently when the plate current was increased to more than 5 ma.	Cause of trouble was arcing over at the filament leads inside the corona shields. By replacing the filament clamps in a vise it was possible to pull out the wires far enough so that a new section of insulation was next to the coil tube. The filament clamps were then unsoldered and removed and a section of heat resistant spaghetti slipped over each wire where the frayed and burned insulation was. The filament clamps were then soldered back to place and the whole assembly put back into the transmitter. All of the tube clamps, grid bars and clamps, bases and coupling straps were replaced with a set that had been resilver-plated.
No horizontal deflection on indicator screen.	Found frayed insulation on 8014A filament lead was shorted to corona shield. Repaired insulation.

Transmitter—Continued

NATURE OF OPERATION	TROUBLE FOUND AND REMEDY
Instability of trace.	Corrected by increasing locking voltage.
Jitter in the trace.	Traced to arcing of the filament leads inside L–102 from leads to tubing. This was caused by fraying of filament leads at the filament strap connector end, and accordingly, a new L–102 assembly was built up complete in the radar shop and installed in the transmitter.
The equipment became inoperative due to multiple sweep.	Tried adjusting the grid resistance and locking voltage without success. Tried changing the oscillator tubes, but this made no difference. Tested all grid resistors and condensers. Everything checked very good. It was found that by adjusting the grid tuning slightly the multiple trace was eliminated.
No filament voltage on V–101 and V–102.	Stranded pigtail wire on plate Variac T–203 broken. Resoldered broken wire—normal.

Receiver Indicator

Radar inoperative. Lack of horizontal deflection on CR tube.	The cause was a leaky coupling condenser, C–242, which had a measured resistance of 40,000 ohms.
Occasionally the receiver would have very low gain for short intervals.	The ground lugs in the r-f amplifier were regarded with suspicion. All ground connections were soldered with aluminum solder in the receiver chassis. The intermittencies did not recur.
Astigmatism in scope was not fully corrected by moving second anode to −100 volt tap.	A potentiometer which varies the anode potential from −100 to −300 was added. Good focus can now be obtained.
Intermittent bouncing up and down of trace on screen and frequent distortion of trace.	⅜-inch coaxial line plug was loose, and was finally found to be cause of intermittent condition.
Image on indicator screen unstable. Image would periodically jump one inch to the left, then back again.	Traced unstable operation to be caused by intermittent connection in duplexer unit.
Range indicator unit failed.	Found 2X2/879 H. V. (V–316) rectifier tube faulty. Replaced.
No sweep visible on indicator tube.	Replaced C–255 in receiver-indicator.
Vertical deflection on screen was noted as being only 1 inch high.	Checked video amplifier and found the screen bypass capacitor, C–232, was shorted to the metal case. Replaced. Vertical deflection then returned to normal.
Echoes very weak, necessary to advance receiver gain fully to receive even slight response.	Checked receiver and found dead 9001 tube (V–202) in second r-f stage. Replaced.
Lost trace on screen.	Investigated and isolated trouble to cathode ray circuit. Transformer, T–202, short-circuited in primary. Installed spare.
Erratic marker operation.	Corrected this by replacing 6SN7 (V–214) tube and 6V6 (V–213) blanking tube in the receiver indicator.
No trace on indicator.	Found leaky capacitor (C–238), in sweep circuit.
Horizontal sweep not functioning properly.	Resistor (R–242) in grid of horizontal sweep tube V–211 was burned out. Replaced.

Receiver Indicator—Continued

NATURE OF OPERATION	TROUBLE FOUND AND REMEDY
A marked amount of jittering of the markers was noticed after about 6 hours of operation.	This was remedied by adjusting the variable condenser in the multivibrator circuit.
As the transmitter plate voltage was increased, the range markers would jump to the right. At the particular voltage setting the location of the markers shifted intermittently.	Shifted the tuning condenser in the tuned circuit that locks the marker multivibrator slightly so that their location was stable for all settings of the plate voltage Variac.
Intermittent deflection of sweep to the right of screen was experienced. This derangement did not make gear inoperative but merely caused a shifting of range readings to the right.	Condenser C–239 had a high resistance leak. Upon replacement, the equipment functioned perfectly.
Sweep disappeared on 60-mile range.	Condenser C–271, No. 481036–B10, was found to have 500,000 ohm leak which caused a reduction in plate voltage on tube V–211. Replacement of this condenser restored operation to normal.
The tuning slug in the first r-f (9001) stage in the receiver was shorting to the coil over a portion of the tuning range.	Condition was remedied by placing a new strip of scotch tape over the slug and recentering the coil.
Lack of blanking action in the indicator circuit.	Traced to an open plate resistor in the blanking tube circuit, R–253. Replaced.
The sweep on the CRO seemed to start about one-quarter of the way from the right of where it should start, sweep to the left and then turn around and sweep normally from left to right.	R–245 which was open circuited. Replacement restored normal sweep.
The markers were very unstable, at times completely cutting off.	The trouble was found to be a defective socket (X–214) contact. This was repaired.
Complaint was made of a short trace on the indicating scope during the warmup period of the equipment.	Traced to a leaky condenser, C–241, in the sweep generating circuit in the indicator.
The sweep was found about two-thirds normal and the trace distorted.	Replacement of the 6V6 tube (V–211) restored normal sweep.
The SD was tested within 20–30 miles of land and no echoes were present. Again all tubes and wiring was checked and found in proper condition. Further search led to finding a salt deposit on the side of one of the filter condensers (in the i-f amplifier) which are used as filters for the power supply.	This condenser was cleaned and placed back in the circuit with subsequent rise in echo height. Further rise in echo height was obtained by changing 9001's and 9002's until a set was found that gave better results.
Lost trace on screen.	Investigated and isolated trouble to cathode ray circuit. Transformer, T–202, short circuited in primary. Installed spare.
Erratic marker operation.	Corrected this by replacing 6SN7 (V–214) tube and 6V6 (V–213) blanking tube in the receiver indicator.
Loss of sensitivity.	Due to failure of RC circuit. Sensitivity potentiometer and C–236 burned out causing loss of "grass."
No trace on indicator.	Found leaky capacitor, C–238, in sweep circuit.
Horizontal sweep not functioning properly.	Resistor (R–242) in grid of horizontal sweep tube V–211 was burned out. Replaced.
The phase inverter tube was not functioning all of the time. As this tube was jiggled, the trace would shift to the left.	Tightened all of the contact springs in the 6C5 (V–212) phase inverter socket. This corrected the intermittent trouble.

TROUBLE SHOOTING HINTS

No Trace on Indicator Screen

a. Check 8014A filament leads for shorts to ground inside the corona shields.
b. Check pulse cable from transmitter to receiver-indicator for possible open or short.
c. Measure socket voltages of tubes listed below.
d. Tubes to check:
V-211—6V6GT Sweep Tube
V-213—6V6GT Blanking Tube
V-217—905 CRO Tube
V-216—2X2 H.V. Rectifier
V-215—5U4G L.V. Rectifier

Short Horizontal Trace

a. Make sure both horizontal plate connectors are connected to the 905 CRO tube.
b. Measure socket voltages of tubes indicated under d.
c. Check sweep circuit resistors and capacitors, particularly C-270, C-271.
d. Tubes to check:
V-212—6J5 Phase Inverter Tube
V-211—6V6GT Sweep Tube

Trace Has Horizontal Jitter

a. Check for arcing of 8014A filament leads inside corona shields.
b. Tubes to check:
V-211—6V6GT Sweep Tube
V-212—6J5 Phase Inverter Tube

Return Trace Appears on Screen with Normal Intensity Setting

a. Check socket voltages of V-213.
b. Check resistance and capacity values in V-213 circuit.
c. Tubes to check:
V-213—6V6GT Blanking Tube
V-217—905 CRO Tube

Centering Control Lacks Range Needed To Bring the Trace to Normal Viewing Position

a. Check voltage at center arm of R-265 centering control. Should range from approximately plus 50 volts to approximately plus 375 volts as the control is turned.

Trace Appears But No Grass or Echoes

a. Check tuning of r-f stages. CAUTION: Do not readjust the i-f transformer tuning.
b. Make certain the connector to the 905 CRO bottom deflection plate is in place.
c. Measure socket voltages of all tubes listed under d.
V-201 9001 1st r.f.
V-202-9001 2d r.f.
V-203-9001 3d r.f.
V-204 9001 Detector
V-205 9002 Oscillator
V-206 6SK7 1st i.f.
V-207 6SK7 2d i.f.
V-208 6SK7 3d i.f.
V-209 6H6 2d Detector
V-210 6AG7 Video Amplifier

Grass Appears on Screen, But No Echoes

a. Check receiver antenna input cable for open or short circuit.
b. Duplexer may be detuned from normal setting.

Unstable Echoes (Vertical Jitter)

a. Check for internal arcing in transmitter tuned circuits.
b. Check transmission line and receiver input coax for faulty connections.
c. Explore receiver chassis, especially r-f section for possible loose connections or intermittent capacitors.
d. Tubes to check:
V-104—1960 Duplexer Tube.

No Transmitter Plate Current

a. Check plug P-202 for open connections.
b. Test fuses F-101, F-102.
c. Check interlocks on transmitter door for positive contact.
d. Dheck relay K-101 for positive action.
e. Tubes to check:
V-101, V-102—8014A Osc. Tube
V-103—8013 H.V. Rectifier

Abnormally High Transmitter Plate Current

a. Transmitter grid leak should be 0.5 meg or 1.0 meg.
b. Check 8014A filament voltage, 14.3 v is normal.
c. Check grid capacitor C-101 for leakage.
d. Tubes to check:
V-101, V-102—8014A Osc. Tubes

Transmitter Pulsing at Half, Double, or Random Frequency

a. Check transmitter grid leak. Should be 0.5 to 1.0 meg.
b. Vary locking voltage transformer taps.
c. Make certain transmitter frequency is not set close to a "skip frequency."
d. If the transmitter cannot be tuned to a frequency within the specified limits, the transmission line may be at fault. A megger test should be made of the line inside the mast, to determine whether the line is leaking between conductors or to ground. Acceptable limits are between 1 and

5 megohms between conductors, and a similar reading above ground. Should the megger test of the transmission line show a lower reading, the antenna should be removed, and the line cleaned and dried.

e. Tubes to check:
V-101, V-102—8014A Osc. Tubes

No Range Markers or Range Markers Unstable

a. Check socket voltages of V-214.
b. Check switch S-204A, for positive contact.
c. Tube to check:
V-214—6SN7 Multivibrator

Technician's Checkoff List (SF, SF–1)

The maintenance procedures outlined in this checkoff list were collected from data submitted by vessels, navy yard and manufacturers' radar field service engineers. This checkoff list is to be used by the ship's radar technician or other radar personnel equally qualified. The checkoff list should be made effective immediately upon receipt of this information. A copy of this checkoff list (preferably typewritten) should be made for future use.

NOTE: After completion of each item check (√) in appropriate blank space.

	Year___											
	Month_											
	Week__	1	2	3	4	1	2	3	4	1	2	3	4
TRANSMITTER CONVERTER													
1. Lubricate blower motors B–201, B–202.			X	X	X		X	X	X		X	X	X
2. Check brushes in blower motors B–201, B–202.													
3. Clean commutator in blower motors B–201, B–202.			X	X	X		X	X	X		X	X	X
4. Check operation of interlock, S–202.			X	X	X		X	X	X		X	X	X
CONVERTER AND RANGE PLAN POSITION INDICATOR													
1. Lubricate PPI motor, B–401.			X	X	X		X	X	X		X	X	X
2. Check brushes in PPI motor B–401.													
3. Clean commutator in PPI motor B–401.			X	X	X		X	X	X		X	X	X
4. Lubricate PPI ball bearings.			X	X	X		X	X	X		X	X	X
5. Lubricate drive for range potentiometer R–406. (SF–1 only.)			X	X	X		X	X	X		X	X	X
6. Clean interior of cabinet and chassis.													
7. Clean PPI lucite window.													
8. Clean face of PPI tube.													
9. Clean PPI deflection brushes and slip rings.													
10. Lubricate PPI gearing.			X	X	X		X	X	X		X	X	X
11. Lubricate PPI training shaft.			X	X	X		X	X	X		X	X	X
12. Lubricate operating bushing for switch S–404.			X	X	X		X	X	X		X	X	X
13. Check rigidity of range switch S–401.			X	X	X		X	X	X		X	X	X
14. Lubricate shaft of tuning potentiometer R–506.			X	X	X		X	X	X		X	X	X
15. Lubricate shaft for range potentiometer R–406. (SF only.)			X	X	X		X	X	X		X	X	X

Technician's Checkoff List (SF, SF–1)—Continued

	Year											
	Month											
	Week	1	2	3	4	1	2	3	4	1	2	3	4
CONVERTER AND RANGE PLAN POSITION—continued													
16. Check operation of interlocks S–406 and S–407.			X	X	X		X	X	X		X	X	X
17. Check condition of the wiring from chassis to terminal blocks.			X	X	X		X	X	X		X	X	X
ANTENNA ASSEMBLY													
1. Check lubricant in the gear box.			X	X	X	X	X	X	X	X	X	X	X
2. Lubricate echo box motor B–102.			X	X	X	X	X	X	X	X	X	X	X
3. Lubricate echo box motor gears.			X	X	X	X	X	X	X	X	X	X	X
4. Lubricate antenna drive motor B–101.			X	X	X	X	X	X	X	X	X	X	X
5. Check brushes in antenna drive motor B–101.			X	X	X		X	X	X		X	X	X
6. Clean commutator in antenna drive motor B–101.			X	X	X		X	X	X		X	X	X
7. Check rigidity of motor coupling.			X	X	X		X	X	X		X	X	X
8. Check brushes in echo box motor B–102.			X	X	X		X	X	X		X	X	X
9. Clean commutator in echo box motor B–102.			X	X	X		X	X	X		X	X	X
10. Lubricate selsyn gears.			X	X	X	X	X	X	X	X	X	X	X
11. Check alinement of selsyn gears.			X	X	X	X	X	X	X	X	X	X	X
12. Check alinement of limit switches S–101 and S–102.			X	X	X	X	X	X	X	X	X	X	X
13. Check for moisture in interior of unit.													
14. Check for cracks in radome.													
MOTOR GENERATOR SET													
1. Lubricate motor B–801.			X	X	X	X	X	X	X	X	X	X	X
2. Lubricate generator G–801.			X	X	X	X	X	X	X	X	X	X	X
3. Lubricate exciter.			X	X	X	X	X	X	X	X	X	X	X
4. Check rigidity of coupling.			X	X	X		X	X	X		X	X	X
5. Lubricate coupling.			X	X	X	X	X	X	X	X	X	X	X
6. Check brushes in motor B–801.													

Technician's Checkoff List (SF, SF–1)—Continued

	Year___											
	Month_											
	Week__	1	2	3	4	1	2	3	4	1	2	3	4
MOTOR GENERATOR SET—continued													
7. Clean commutator, motor B–801.			X	X	X		X	X	X		X	X	X
8. Check brushes in generator G–801.													
9. Clean slip rings in generator G–801.			X	X	X		X	X	X		X	X	X
10. Check brushes in exciter.													
11. Clean commutator in exciter.			X	X	X		X	X	X		X	X	X
12. Clean interior of all units.			X	X	X		X	X	X		X	X	X
13. Check and clean brushes and slip rings on speed governor.													
14. Check contacts of speed governor.													
15. Check rpm of motor and adjust if necessary to 3,450 rpm.			X	X	X		X	X	X		X	X	X
VOLTAGE REGULATOR													
1. Check battery E–301 for leakage, corrosion, etc.			X	X	X		X	X	X		X	X	X
2. Check voltage of battery E–301 and replace if low.			X	X	X		X	X	X		X	X	X
3. Clean interior of unit.			X	X	X		X	X	X		X	X	X
4. Check shock mounts.			X	X	X		X	X	X		X	X	X
MAGNETIC CONTROLLER													
1. Check operation of moving parts.			X	X	X		X	X	X		X	X	X
2. Check and clean contacts.			X	X	X		X	X	X		X	X	X
3. Check timing of delay mechanism.			X	X	X		X	X	X		X	X	X
4. Clean interior of unit.			X	X	X		X	X	X		X	X	X
CONTROL RECTIFIER													
1. Clean interior of unit.			X	X	X		X	X	X		X	X	X
2. Check shock mounts.			X	X	X		X	X	X		X	X	X
TUNING CONTROL BOX													
1. Clean interior of unit.			X	X	X		X	X	X		X	X	X

Technician's Checkoff List (SF, SF-1)—Continued

		Year___											
		Month_											
		Week__	1	2	3	4	1	2	3	4	1	2	3	4
TRUE BEARING CONTROL													
1. Lubricate step-by-step motor B–1301.				X	X	X		X	X	X		X	X	X
2. Clean interior of unit.				X	X	X		X	X	X		X	X	X
3. Check rigidity of switch S–1301.				X	X	X		X	X	X		X	X	X
TIME DELAY RELAY													
1. Check timing of relay K–301.													
2. Check timing of relay K–801.													
3. Check timing of relay K–601.													
4. Check timing of relay K–201.													
The technician should make the following checks, etc., daily:													
1. Check temperature of local oscillator cavity and adjust thermostat if necessary.	S												
	M												
	T												
	W												
	T												
	F												
	S												
2. Check operation of error warning lamp I–407.	S												
	M												
	T												
	W												
	T												
	F												
	S												

Technician's Checkoff List (SF, SF–1)—Continued

		Year___											
		Month_											
		Week__	1	2	3	4	1	2	3	4	1	2	3	4
TIME DELAY RELAY—continued														
3. Check operation of heater resistors R–558, R–559, and R–560.	S													
	M													
	T													
	W													
	T													
	F													
	S													
4. Check accuracy of bearing readings.	S													
	M													
	T													
	W													
	T													
	F													
	S													
5. Check the color of the silica gel indicator crystals beneath the dehydrating unit.	S													
	M													
	T													
	W													
	T													
	F													
	S													
6. Check operation of indicator lamp I–1101.	S													
	M													
	T													
	W													
	T													
	F													
	S													

At the beginning of each watch, the operator should make the following checks:
1. Check value of magnetron current and crystal current. 2. Check range calibration.
3. Check a-c voltage reading on meter M–1001. 4. Check reading of true bearing control kit against a gyro repeater.
After every 300 hours of operation, the technician should replace the TR tube V–211, clean the screen of blower motors B–201 and B–202 and clean interior of the radar transmitter converter unit.

LUBRICATION CHART (SF, SF–1)

Proper maintenance requires periodic lubrication of the various components. This chart is intended to reference the units involved, time serviced, and to give the Navy type number if available. Reference must also be made to the instruction book for location of lubrication points and the quantity of lubricant required.

Equipment			Service					Lubrication data						
Unit involved	Name of component	Circuit symbol	Hours	Daily	Weekly	Monthly	Annual	Oil	Grease	Instruction book type	Commercial type	Navy type	Nearest Navy equivalent	Alternates
Motor-generator	Motor	B–801					Q		X	Beacon M–285	M–285		ANG–3	OS–1350.
	Generator	G–801					Q		X	Beacon M–285	M–285		ANG–3	OS–1350.
	Exciter						Q		X	Beacon M–285	M–285		ANG–3	OS–1350.
	Coupling						Q		X		M–285		ANG–3	OS–1350.
Antenna	Gear box						S		X	Beacon M–285	M–285		ANG–3	OS–1350.
	Motor (training)	B–101					Q		X	None			14–L–3 Grade 1	OS–1350.
	Motor (echo box)	B–102					S		X	None			14–L–3 Grade 1	OS–1350.
	Echo box gearing						S		X	Andok "C"	Andok "C"		14–L–3 Grade 3	OS–1350.
Receiver-indicator	Motor (PPI)	B–401					Q		X	None			14–L–3 Grade 1	OS–1350.
	Ball bearings (PPI)						Q		X	Singer grease			ANG–3	OS–1350.
	Training shaft				X			X		Oil	SAE #40		2110	9110.
	Sleeve for S–404				X				X	#10			ANG–3	OS–1350.
	Gearing (PPI)				X			X		#10	SAE #10		2110	9110.
	Shaft for R–506				X			X					2110	9110.
	Shaft for R–406 (SF)				X			X					2110	9110.
	Drive for R–406 (SF–1)						Q		X				ANG–3	OS–1350.
Transmitter	Motors (blower)	B–201–'2				X		X		Oil	SAE #10		2110	9110.

S=Semiannually. Q=Quarterly.

PRECAUTIONS AGAINST HUMIDITY

Due to excessive humidity in SOPAC area, the following precautions should be observed in the maintenance of SF radar.

A close check should be kept on the dehydrator cartridge and replacements should be made as soon as the indicator starts turning pink. A maintenance part is furnished with each equipment and this should be available and in good condition for immediate replacement. Normally, 2 to 3 weeks' service is all that can be expected from each one before taking out.

All bolts on the transmitter cover must be securely tightened and worn gaskets should be replaced. Should it become necessary to remove the cover to effect repairs, replace as soon as possible to prevent accumulation of moisture in this unit.

The receiver-indicator unit is kept dry by means of heater resistors which are turned on as soon as the equipment is turned off. These resistors R-558, 559, 560, are mounted one on each of the bakelite panels below the unit. The 110-volt d-c supply to the equipment should never be disconnected from the ship's line, even if the equipment is shut down, since the heater would thereby be turned off. Periodically the heater resistors should be checked for open circuits.

A regular inspection of the antenna is recommended since apparently considerable condensation takes place in this unit. Wipe out with a dry cloth. Lubricate selsyn bearings sparingly to prevent rust, using Torpedo Gyro oil, or Standard Oil Univis No. 48. See page 70 of the instruction book for lubrication details of the antenna assembly. When replacing hood, be sure that all bolts are securely tightened.

ADJUSTING AND TUNING R-F COMPONENTS

The following discussion was prepared at the request of the Bureau of Ships. This information is reprinted for information to SF and SF-1 radar-equipped vessels. Radar personnel are urged to read this material and study it carefully before attempting any readjustments. When making an adjustment, always note the exact positions of the controls in the event trouble is experienced and it is necessary to reset the equipment to the original settings. (Refer to fig. 1).

Initial Setting of Loops and Probes. a. The TR cavity output loop assembly should be screwed in the TR cavity approximately three full revolutions after the first thread catches and the loop on this assembly should be set in a vertical position as indicated by the marker on the hex nut portion of the assembly. The locking nut should then be tightened up against the outside of the cavity taking care not to tune the loop away from the vertical while locking this nut.

a. The signal input probe assembly of the left-hand side of crystal mixer should be screwed into the mixer cavity far enough to allow approximately 0.020 inch (twenty thousandths inch) clearance between probe face A and center post in mixer cavity. The limits of this clearance

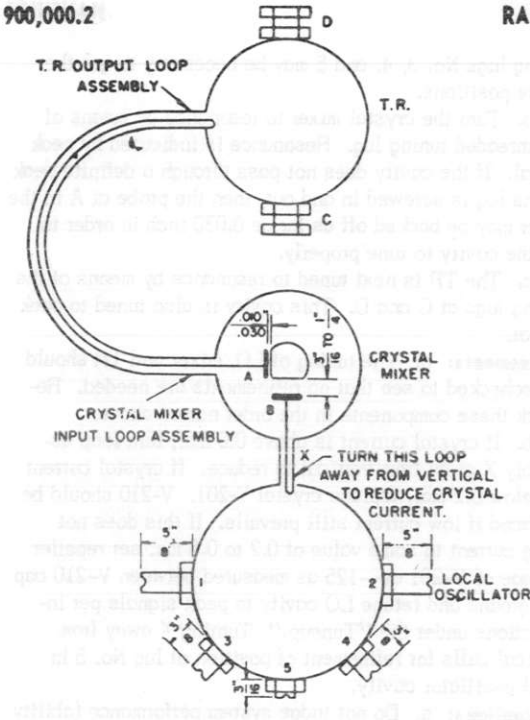


FIGURE 1.—Schematic of r-f components.

are 0.010 inch to 0.030 inch. If the cavity does not tune through resonance, the probe may be backed off to 0.030 inch. It should never be closer than 0.010 inch.

c. The local oscillator probe B in the front of the crystal mixer should be adjusted so that there is 3/16-inch to 1/4-inch clearance between its face and the center post of mixer cavity. The locking nut should be tightened so that the loop in local oscillator cavity on the opposite end of this line is in a vertical position as indicated by the marker on the hex nut portion of this assembly. If crystal current is excessive (over 0.60 ma.), this loop should be turned away from vertical to reduce current.

d. The tuning lugs in the local oscillator cavity should be set initially to the positions shown in figure 1.

Tuneup: a. Set local oscillator tuning potentiometer R-506 on receiver indicator so that the repeller voltage is approximately—50 volts as measured from cap of V-210 to ground. Adjust tuning lug No. 5 (see fig. 1) until maximum targets appear on "A" scope. There should be more than one position of this lug where targets are tuned in, and it is advisable to use the position that gives highest crystal current.

It should not be necessary to make any adjustments of lugs Nos. 1 and 2. It may be necessary to screw lugs Nos. 3 and 4 in or out a few turns if either or both modes are not found when tuning lug No. 5. Lugs Nos. 3 and 4 should be adjusted in unison; that is, if necessary to tune No. 3 in four revolutions to reach the desired mode, it would be better to tune No. 3 in 2 revolutions and No. 4 in 2 revolutions. The relationship of the four lugs should be approximately the same as shown in figure 1: Nos. 1 and 2 farthest out of the cavity, Nos. 3 and 4 not quite so far out and No. 5 farthest in cavity. A little refinement of

tuning lugs No. 3, 4, and 5 may be necessary to get the above positions.

b. Turn the crystal mixer to resonance by means of the threaded tuning lug. Resonance is indicated by peak signal. If the cavity does not pass through a definite peak as the lug is screwed in and out, then the probe at A in the mixer may be backed off as far as 0.030 inch in order to get the cavity to tune properly.

c. The TR is next tuned to resonance by means of the tuning lugs at C and D. This cavity is also tuned to peak signal.

Refinements: a. The tuning of LO, mixer and TR should be rechecked to see that no refinements are needed. Recheck these components in the order named above.

b. If crystal current is above 0.6 ma., turn loop assembly X away from vertical to reduce. If crystal current is below 0.2 ma., replace crystal Y-201. V-210 should be replaced if low current still prevails. If this does not bring current to some value of 0.2 to 0.6 ma. set repeller voltage of V-201 at—125 as measured between V-210 cap and ground and retune LO cavity to peak signals per instructions under the "Tuneup." Turning X away from vertical calls for refinement of position of lug No. 5 in local oscillator cavity.

Precautions: a. Do not judge system performance (ability of system to detect targets or saturated ring of echo box) with crystal current below 0.2 ma.

b. The above tuneup procedure is not necessary in full unless TR box, crystal mixer or local oscillator cavity has been replaced, or components have been badly misadjusted. In other words, once these adjustments are made properly, none should be changed except LO tuning screw No. 5 and crystal mixer tuning lug. However, if V-205 is replaced, it undoubtedly will be necessary to retune the TR cavity also.

c. Watch out for high voltage! There are 300 volts on the LO cavity, approximately 400 volts on the cap of TR tube and 12,000 volts at numerous other points in the pulser.

d. The radar operator should be instructed to use the local oscillator repeller voltage mode that gives normal crystal current.

If the local oscillator is tuned up on the low repeller voltage mode, the crystal meter may go off scale when the repeller voltage is adjusted to the high voltage mode. On the other hand, if the cavity is tuned up on the high voltage mode, the crystal current will be below normal when the operator tunes the cavity to the low voltage mode.

e. Care should be exercised to be sure that the LO is kept tuned at resonance (using R-506) while the crystal mixer cavity and TR cavity are being tuned.

USE OF SF ECHO BOX

The echo box is a means for tuning SF radar and checking the system performance while at sea. It furnished a false echo, which should be used for periodic "L.O. TUNING" adjustments in the absence of natural targets.

The engineers installing the gear should furnish the ship with the following information when final check is made. This data should be logged.

1. Azimuth bearing of antenna as measured on PPI scope.
2. Maximum meter deflection on microammeter.
3. Measurement of the saturated echo (ringing time) on the "A" scope.
4. Measurement of front to back resistance of crystal rectifier in the output of echo box.

Echo Box Tuning Procedure: a. Rotate antenna to bearing given in 1 bove.

b. Set receiver gain for about 1/8-inch of "grass" and make certain that range calibration is correct.

c. Tune the echo box by means of reversing switch on TUNING CONTROL until the current reading on the microammeter is a maximum. This reading should be given in 2 above but it will probably vary 10 percent from day to day. The TUNING CONTROL will operate in either direction until the light goes out.

d. A solid, saturated echo should now appear on the "A" scope, the length of which is the ringing time. This should very closely equal the value given in 3 above. Tune L.O. TUNE control for maximum ringing time. The ringing time should be measured where it falls into the "grass" and if this reading is two or three hundred yards less than value given in 3 above, the set is considerably below optimum performance.

System Analysis: a. ABNORMALLY LOW MICROAMMETER READING. If this reading falls off appreciably, check the front to back resistance of the crystal by removing the four screws holding the microammeter face. Pull out the meter a few inches—remove lugs on one terminal and measure the resistance between the loose cable and other terminal in both directions—using OE-6, d-c meter set at R-100 ohm scale. If resistance ratio is much less than that given in 4 above, change crystal (maintenance parts tag No. 99) by removing lug under antenna mounting plate. Record new values. If the crystal is found satisfactory, the low current indicates transmitter trouble or generally, decrease in power output. This will also reduce ringing time. Check magnetron current (should read six), tubes in pulser unit and transmitter circuit.

b. LOW RINGING TIME. Low ringing time with no change in microammeter reading indicates receiver trouble. The following should be checked:

(1) L.O. Tuning.
(2) Bad crystal mixer (1N21 rectifier) or McNally tube.
(3) Low crystal current (should be between 0.3 and 0.5).
(4) Detuned crystal mixer or McNally cavity.
(5) Preamplifier tubes.
(6) Receiver strip tubes.
(7) Receiver circuit in general.

c. MISCELLANEOUS INDICATIONS. If the antenna is rotated automatically while echo box is in tune, an "antenna pattern" will be seen on the PPI scope. This should consist of a smooth major lobe with two minor side lobes. If the edges of the figure are jagged, the magnetron or some of its component parts are defective—or low line voltage exists.

If the microammeter needle fluctuates when antenna is set at proper bearing, the line voltage might be unstable or intermittent arcing might be taking place in coax.

Always detune echo box before continuing radar regular watch.

PAINTING ANTENNA HOOD

It is allowable to paint the exterior of the antenna hood with any of the common paints such as camouflage gray, usually available at navy yards. The only restriction as to the type of paint used is that it contain no metallic flakes in its composition. This rules out aluminum, gold, and similar paints. It is permissible to use what is commonly called "lead paint" because in this paint, lead is not used in its metallic state, but it is chemically compounded (usually as an oxide) so it no longer has the shielding properties to high frequency radiation that a pure metal has. However, as a general rule never permit more than three coats of paint to be applied without carefully removing the old paint so as not damage the dome.

ANTENNA ASSEMBLY SERVICE NOTES

Addition of G.E. Type 5G Selsyn: When the receiver-indicator is modified an additional selsyn, G.E. type 5G, will be added to provide synchronizing voltage for remote PPI units. It will be necessary to change the cable entrance to permit use of a MHFA-22 cable and suitable terminals for the selsyn.

Bypassing Limit Switches: Two 0.1 μfd, 600-volt d-c capacitors are added to the echo box, connected between the respective limit switches and terminal No. F1 on the antenna terminal panel. This change is necessary to prevent arcing across the switch contacts.

Shunt-Wound Echo Box Motor: In order to overcome objectionable noise introduced into the system when a series-wound echo box motor, B-102, is in operation motor is changed to shunt-wound. This change is incorporated in SF Serial No. 1306.

At the same time, a terminal strip is mounted on the echo box base plate to facilitate motor replacement.

The above changes require that the model designations be changed to 922C.

CHANGE TO TUNING CONTROL BOX. When the echo box motor, B-102, is changed from series to shunt-wound, the tuning control box is also changed as follows:

The pilot lamp, I-1101, is changed to 110-volt, 60 watt; resistor R-1101 is removed; and condenser C-1101 is installed.

The above changes the tuning control box model designation to 944A.

TRANSMITTER-CONVERTER FAILURES DUE TO MOISTURE

There are many failures of the SF/SF-1 transmitter converter which can be attributed to moisture. These breakdowns occur gradually and unless stopped in time will result in the complete inoperation of the radar as well as failure of components. Replacement of such components will temporarily restore the radar's operation but the breakdown will occur again. Moisture in the transmitter can be detected by any one or all of the following symptoms.

Symptoms:

a. Gradual lowering of magnetron current.
b. Failure of fuse F-202 or F-201.
c. Failure of potentiometer R-247.
d. Excess load on rectifiers V-208 or V-209.
e. Improper grid bias on V-214 and V-203.

The failure of or change in value of resistor network R-249, 250, 212, 213, 242, 243, 248.

g. Failure of V-214 or V-203.

Cause: This trouble is caused by moisture and/or fungus creating leakage paths between terminals on the two bakelite driver panels (section on which are mounted the 233A and the 829). The leakage is usually between the resistor tie points and may progress to the point where actual carbonization of a path is created. Another prevalent point for this failure is where the feed-through insulator carrying H.V. to the plates of V-202 (829) passes through the horizontal panel. This leakage usually shows up on the under side of the horizontal panel between the center conductor and some grounded lug on the panel.

Cure: Unless moisture has impregnated the panels to the extent of creating a carbonized path, this trouble can be cured by placing a cloth sack of silica gel or other dehydrating material inside the transmitter. A very convenient place to put this material is underneath the magnetron between the coax and the side of the case.

Be sure that the transmitter cover is on securely and that the cork gasket is in place. After operation of the transmitter for several hours most of the moisture will have been absorbed by the hygroscopic material. However, in difficult cases it may be necessary to change the dehydrating agent every 2 or 3 weeks. At such times care must be taken to replace the transmitter cover as soon as possible.

If an actual carbonized path exists on the panels, the only cure is to replace the panel or in the case of the feed-through insulator mentioned above, remove the lead that goes from the feed-through insulator to resistors R-249 and R-250. Then run a well-insulated wire from R-249 and R-250 outside the panel to R-217 and R-219. R-217 and R-219 will have to be disconnected from the top of the feed-through insulator.

If a carbonized path is discovered on the vertical panel, as an emergency measure, a slot could be cut in the bakelite panel across the carbonized path and then the transmitter should be dehydrated as in the first paragraph above.

Remarks: In installations where any of the above symptoms exist or gradually come into being (example: gradual lowering of crystal current which can't be accounted for by bad crystal or defective McNally), the transmitter should be dehydrated. It is also advisable to follow the above procedure whenever the transmitter has been standing idle for a considerable period or when the cover has been off for any length of time. The regular dehydrating system should, of course, be kept in operation and the cartridges changed whenever necessary.

REPLACING MAGNETRON IN TRANSMITTER-CONVERTER

Instructions for Changing the Magnetron

PRECAUTIONS: Unless the radar main switch is open, the 115 v. d-c supply is being fed to the local oscillator cavity heater, even though the radar equipment is otherwise secured and fuses F-201, F-202, F-203 and F-204 removed.

In the transmitter-converter unit, condensers C-213 and C-215 will hold heavy charges. Where safety switches have been installed, condenser C-215 will be automatically discharged when the transmitter cover is removed. However, in all cases, condenser C-215 should be treated with the greatest respect, because it is capable of accumulating a high static charge while the equipment is not in operation. Condenser C-213 should be discharged before attempting to work around the transmitter.

The extremely strong permanent magnet (1400 gauss) has a detrimental effect upon watches, even nonmagnetic types, and other delicate instruments.

Removing the Magnetron V-205

a. The magnet should be removed as follows:

(1) Remove the four magnet mounting screws A which secure the magnet M to the yoke Y, and lift the magnet straight up. (See fig. 1.)

(2) Set the magnet carefully to one side where it will not attract any iron or steel particles, and place a keeper between the pole pieces.

CAUTION: Handle the magnet carefully, as any jarring tends to reduce its magnetic strength. Do not allow tools or other metallic objects to be pulled forcibly to it for the same reason.

b. V-205 should then be removed as follows:

(1) Remove the two filament lead plugs P from the jacks J in the base of the magnetron, V-205 (see figs. 2 and 4).

(2) Loosen the two top clamp screws B until clear of the yoke Y and swing the clamps H sideways to release the magnetron (see fig. 2).

(3) Lift the magnetron straight up until the output probe E is clear of the coaxial line L (see figs. 2 and 4).

CAUTION: Care must be exercised in handling this tube, as the glass seal S of the output probe E is quite easily damaged (see fig. 4). If available, it is advisable to install the bakelite protector on the output probe threaded portion T (see fig. 4).

Installing the Magnetron V-205:

a. The magnetron should be placed in its mounting assembly as follows:

(1) The tube will slide easily into place if the output probe E is inserted in the center of the inner conductor I of the coaxial line L and lowered until the tube rests squarely on the top of the coaxial line L with the threaded portion T of the tube overhanging the coaxial line L evenly all around (see figs. 2 and 3).

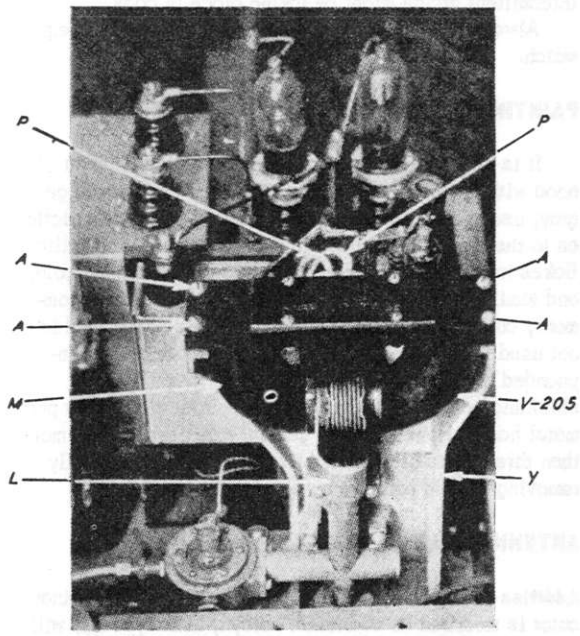


FIGURE 1.—Top view of magnetron assembly.

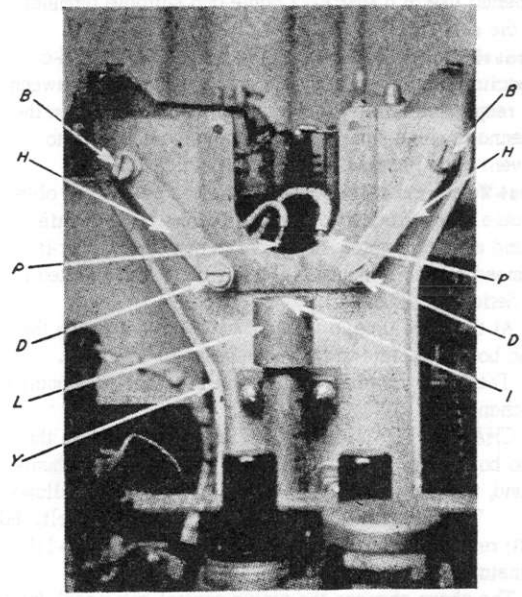


FIGURE 2.—Front view of mounting assembly for magnetron.

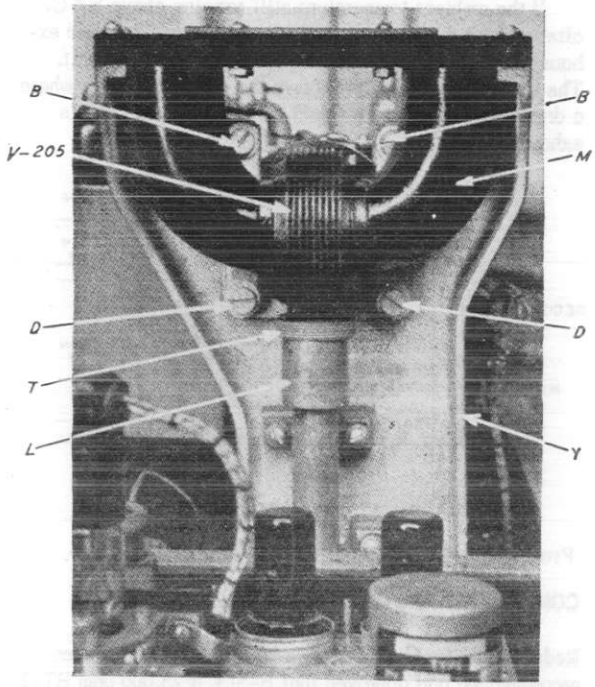


FIGURE 3.—Front view of magnetron assembly.

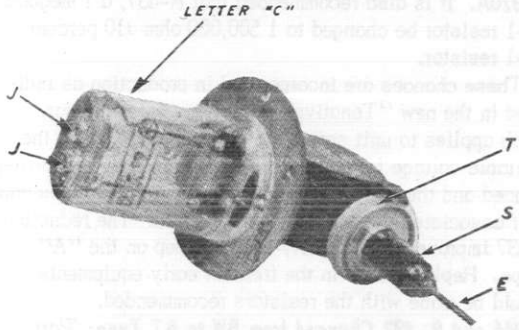


FIGURE 4.—Magnetron V-205.

(2) The two clamps H should then be swung into position to hold the magnetron (see fig. 2), and the top clamp screws B should be started but not tightened (see fig. 3).

b. The magnet should be positioned as follows:

(1) Lower it into the top of the yoke Y in such a way that the nameplate may be read from a position facing the front of the unit (see fig. 1). Some magnets are marked with a red letter "N" on one of the pole pieces. This pole piece should be placed against that side of the magnetron which is marked with a letter "C" on the glass protective cover (see fig. 4).

(2) Start the four magnet mounting screws A, but do not fully tighten them (see fig. 1).

c. The magnetron should be connected as follows:

Plug the filament lead plugs P into the filament jacks J at the base of the magnetron, V-205.

(1) One filament lead, that which is connected at one end to the terminal adjacent to the top of condenser C-213, should be plugged into the filament jack J on the side of the magnetron marked "C" (see figs. 1 and 4). This is the left-hand side as viewed from the front.

(2) The other filament lead should be plugged into the right-hand filament jack J.

d. Position the magnetron with respect to the coaxial line as follows:

(1) The clamps H should be tight enough so that the magnetron will slide easily, but not too freely.

(2) Center the magnetron on the coaxial line and raise it vertically approximately 1/32 of an inch above the coaxial line.

(3) Tighten the top clamp screws B (see fig. 3), making certain that the magnetron does not slip out of place while it is being secured.

e. The magnet should be secured as follows:

(1) Check the magnet M for alignment with the magnetron. The pole pieces of the magnet M should line up with the sides of the magnetron, should be parallel to them and equidistant from them on both sides (see fig. 3).

f. Turn the radar equipment on, and, when the transmitter is operating, listen to see if any arcing occurs between the output probe E and the inner conductor I of the coaxial line L (see figs. 2 and 4). If no arcing occurs, the magnetron has been correctly positioned. If arcing does take place, it indicates that the magnetron output probe E is not correctly positioned with respect to the coaxial line L. In that event, secure the radar equipment, repeat steps d and f above. A slight readjustment of the position of the magnet may be required as per step e.

STANDARDIZATION OF THE KO MAGNETRON TUBE

The KO tube (V-205) in the 921, 921B, and 921C Radar Transmitter Converters has been standardized by the military services, now having a glass base covering the filament leads. This requires that jacks be provided to connect the filament; therefore, flexible leads covered with beads and terminated in banana plugs (Ucinite No. 152064) must be provided.

Tubes in stock will be used for the SF units numbered through serial 50. When stocks are exhausted, future replacements with the new type of tube in the 921 and 921B pulsers will require the addition of the two new filament leads with jacks.

TRANSMITTER-CONVERTER SERVICE NOTES

R-206 Changed in RX233A (V-201) Stage: The 400,000 ohm BT-1/2 resistor, Part No. 738-461, functional No. R-206 in Radar Transmitter-Converter 921B and 921C should be replaced with a 500,000 ohm BT-1/2 resistor. The new type RX-233A has slightly different characteristics, requiring the change in R-206 to permit synchronous operation to be reached by varying R-210. Units in production are using a Globar 500,000 ohm, 1 watt resistor in this alteration until a supply of the BT-1/2 resistors is received in stock.

R-217 and R-219 Changed to 50-ohm BW-2: To effectively eliminate oscillation which has been encountered in the 829 pulse amplifier tube (V-202), the suppressor resistors R-217 and R-219 are changed from 20-ohm, 3-watt Globar

to 50-ohm, BW-2 I.R.C. (S.S. Co. Part No. 738-552). Equipments affect are Radar Transmitter Converters 921A, 921B, and 921C. The change was incorporated in Serial No. 946.

Field Engineers should note that this is a wire-wound resistor and not the carbon BT-2 type.

Change in Bias Voltage to V-203 (Discharge Tube 715A): Resistor R-209, a 10,000 ohm BT-2 resistor, is replaced with a 25,000 ohm BT-2 resistor in the power supply voltage divider circuit. Changing the value of this resistor increases the bias voltage to V-203. Replacements in equipments in the field should be made with a 25,000 ohm resistor, R-248, Part No. 738-101.

Interchangeable Relays for K-201 and K-202: A Dunco relay, type PTAH125 (S.S. Co. Part No. 746-496) is used for K-201 in Radar Transmitter-Converters 921B, 921C and 921D (Serials not specified).

A Dunco relay, type IBXX125 (S.S. Co. Part No. 746-497) is used for K-202.

These relays eliminate the resistor formerly in series with the coil and are interchangeable with relays previously used for K-201 and K-202 respectively.

Safety Switches for Transmitter-Converter 921C: Two safety switches are incorporated in production (Parts 921-3061 and 921-3062). Injury to personnel can result from contact with the high voltage (13 kv) condenser discharge in the event of bleeder resistor failure or rectifier tube failure. These switches automatically discharge the filter condenser when the cover is removed. These switches should be added to units in the field where found necessary.

VENTILATION OF CONVERTER AND RANGE PPI

Numerous complaints have been received from the fleet stating that the Converter and Range Plan Position Indicator has been overheating internally and the operator's space surrounding the indicator is uncomfortably warm.

The ambient temperature of the unit should not exceed 50° C. (122° F.). In the event that the ambient temperature gets above 50° C., the ventilation should be checked in the following order:

Room Ventilation: The room ventilation should conform with BuShips letter PC/S38-1 (816) EN28/A2-11 dated 17 June 9144, which allows for additional ventilation as required.

Surrounding Clearance: The unit installation should conform with Radar Installation Plan as outlined on page D-SF-2, which states that 6 inches of minimum clearance space is necessary in the back and on each side of the unit to assure that adequate air will circulate around the unit.

Shelf Obstruction: The shelf that supports the unit should be of the frame type. However, a few equipments were installed on a solid plate shelf. Holes should be drilled through the solid shelf to allow the air to rise rapidly through the unit. Holes also should be drilled through shelves mounted immediately above the equipment installation.

If the ambient temperature still remains above 50° C. after making the above improvements, a Navy Standard exhaust duct should be added to the top cover of the unit. The top cover view below shows the space available where a drip-proof hole or an air duct can be run to the ship's exhaust system.

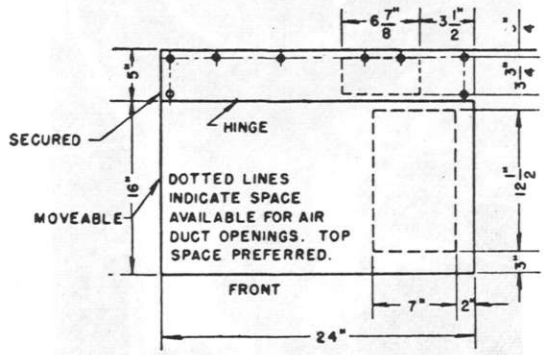


FIGURE 1.—Top view of SF/SF-1 indicator cover.

CONVERTER AND RANGE PPI SERVICE NOTES

Reducing Voltage to First Two I-F Stages: It has been recommended and approved that R-513, a 25,000 ohm BT-1 resistor, be changed to a 15,000 ohm ±10 percent BT-1 resistor in the Converter and Range Plan Position Indicator 920A. It is also recommended that R-437, a 1 megohm BT-1 resistor be changed to 1 500,000 ohm ±10 percent BT-1 resistor.

These changes are incorporated in production as indicated in the new "Tenative Instructions for SF Radar," which applies to unit serial 51. By changing R-513, the available voltage for the first two tubes in the i-f amplifier is reduced and the possibility of overloading these tubes and their associated components is eliminated. The reduction of R-437 improves the linearity of the sweep on the "A" scope. Replacements in the field on early equipments should be made with the resistors recommended.

R-566 and R-492 Changed from BW to BT Type: Part 738-603, a BW resistor used for R-556 or R-492, is to be changed to Part 738-667, a BT resistor.

The BW resistors are wire-wound and are consequently inductive. Inductance in this circuit is a probable cause of inconsistent test results. BT type resistors are to be used in all future replacements; values are 500 ohms, 2 watts.

Rating of C-407, C-423, C-428, C-476 and C-493 Increased: In order to minimize failures of 300 volt working condensers C-407, C-423, C-428, C-476 and C-493 in Converter and Range Plan Position Indicator 920A and 920B, these components should be replaced with Sprague 0.01 μfd, type PX24B, 600 volt working, 1,000 volt test, mineral oil filled condensers (S.S. Co. Part No. 744-662).

Oscillations in Power Supply: It has been found that transients can cause the power supply of Converter and Range Plan Position Indicator 920A to oscillate. Condenser C-454, a 9.01 μfd capacitor, Part No. 744-268, has been added to prevent this type of oscillation; it is connected from the grid of V-416 to ground.

Adding one Megohm Resistor in Series with Arm of R-506: A short at any point along the lead from potentiometer, R-506, to the repeller terminal of V-210 will cause R-506 to burn out in Converter and Range Plan Position Indicator 920A and B (Serials not specified).

In order to protect R-506 under such conditions, a 1-megohm, 20 percent IRC BT-1 resistor should be inserted between the arm of R-506 and terminal No. 13. The resistor is S.S. Co. Part No. 738-833 and should be fastened directly to the arm terminal of R-506.

T-401 Filament Winding Center-Tapped: The 2.5-volt, 7.5-ampere winding on transformer T-401, WX3525 (Part No. 920-432) in Converter and Range Plan Position Indicator 920A and B will be center-tapped. The B+ voltage will be taken from this tap rather than from one side of the filament winding. In order to accomplish this with no additional terminals, the tap on the high-voltage secondary will be internally connected to the 5-volt, 3-ampere winding instead of coming out to a terminal as at present.

This change reduces ripple about 50 percent.

NOTE: When it is necessary to replace T-401, in 920A or B Converter and Range Plan Position Indicator units, with the new type transformer WX 3525A or B, some changes in external wiring will be necessary.

The new transformer will be connected the same as the old type with the following exceptions:

a. The two red leads on the left-hand S-3 terminal are to be placed on the lower right-hand S-1 terminal.

b. The brown jumper from the same lower right-hand S-1 terminal to the left-hand S-6 terminal is to be removed.

Addition of Cable Guard: A fish-paper guard (Part No. 920-480) is to be added beneath the installation wiring cable bracket on Converter and Range Plan Position Indicator 920A and B such that it protects the cable from wear at the hinge caused by opening top of cabinet.

Fuses F-401 and F-402 Changed to 10 Ampere Type: It has been found that even under normal conditions, fuses F-401 and F-402 will sometimes blow. These are to be changed from 5-ampere, 250-volt type to 10-ampere, 250-volt.

The unit requires about 400 watts hot, but under some conditions this may increase to 500 watts for short periods of time, blowing the 5-ampere fuses unnecessarily.

Adapter for PPI Changed: The adapter for the PPI tube base (920-560) is to become 3/4-inch in length instead of 15/16-inch because PPI tubes are now being supplied with another different base. This change will allow the use of all three types of tubes.

Alteration in production started with Unit No. 193 of Converter and Range Plan Position Indicator 920A and B.

RECEIVER-INDICATOR MODIFIED

It has been recommended that at the time echo boxes are added to production SF radar equipment, the following alteration should also be included in Converter and Range Plan Position Indicator 920A.

The tuning-eye, V-423, and associated components are to be removed, and a thin plate provided to cover the hole in the front panel. The tuning-eye amplifier circuits, V-427, and components are to be removed. R-563, C-477, P-408 and J-408 associated with the i-f amplifier are to be removed. R-563, C-477, P-408 and J-408 associated with the i-f amplifier are to be removed, and the lower end of L-409 will connect directly to ground. The blanker, V-403, circuit and components will be removed. Other circuits will be added later to replace those removed.

Due to the fact that an unmodified unit will not be interchangeable with one using remote PPI units, the model number of the receiver-indicator should be changed to 920B.

Because the addition of the echo box makes the tuning-eye circuits obsolete, the tube sockets and some components thereby obtained will be used to include providions for operating remote PPI units.

CRYSTAL PROTECTION

The operators of all SF/SF-1 radars should be catuioned about the necessary protection for the IN21 crystal used in the rectifier circuit Y-201.

Fundamentally the cause lies in improper TR protection from the 721A duplex tube. This adequate protection may be due to defective TR tube or improper keep-alive voltage on the TR tube.

The operator should be informed that when the radar is secured, the keep-alive voltage is removed from the TR tube. This is particularly unfortunate in the case of SC and PC boats where they are docked adjacent to each other. The antenna output is 50 kw. while a blast of 5 watts to the crystal through an inadequate TR protection will burn out the crystal. An attenuation of 40 db is necessary in one space between two ships' antennas. This statement demands that when the operator secures the radar he shall take the proper precautions to see that his antenna does not face an adjacent antenna on a nearby ship.

TUBE TYPE 6V6 FAILURES

Extremely short tube life has been experienced with the 6VC6 video amplifier in the receiver-indicator unit of SF radars installed.

It has been found that the shield over this tube could be removed without any undesirable effects on the operation of receiver indicator unit and by so doing the tube life has been increased to approximately 1,000 hours.

The conclusion is that the tube is failing from undue heating which was alleviated by removing the tube shield.

CHECKING INSTALLATION OF TRUE BEARING CONTROL UNITS

IMPORTANT: All ships equipped with the step-by-step True Bearing Control Units Navy Type CBM-23AEB should check over the installation. The true bearing control unit was incorporated in SF-1 equipments with serial numbers over 1306 and is covered in SF/SF-1 Field Change No. 34.

a. Throw switch S-1301 into "relative bearing" position, thereby cutting synchro SG-1301 completely out of the circuit.

b. Check direction of antenna rotation. On "automatic" training it should rotate clockwise as viewed from above and should follow the training handle on manual retaining.

(1) Any trouble encountered in step b will undoubtedly be due to interconnecting wiring errors.

c. Set the antenna to bear directly over the ship's bow when the PPI indicator is set at 0°.

d. Isolate the step-by-step motor B-1301 from the gyro system by either opening the switch in the step-by-step fused switch box or by removing the external lead from terminal 53 in the CBM-23AEB unit.

e. Set the compass card in the CBM-23-AEB unit at 0° by rotating motor B-1301 manually.

f. Throw switch S-1301 into true bearing position so that synchro SG-1301 is in the circuit.

(1) While step-by-step motor B-1301 does not move synchro SG-1301 acts simply as a transformer inserted in the circuit between synchro SG-401 and the PPI assembly and synchro SG-101 in the antenna, and the antenna should rotate and bear the same as in steps b and c.

(2) If the antenna does not rotate the same as steps b and c, the two stator leads which run from synchro SG-1301 to the terminals marked S-1 and S-2 should be interchanged.

g. Rotate the compass card in the CBM-23AEB unit in a clockwise direction and check to be certain that the antenna follows in a clockwise direction when viewed from above.

(1) If the antenna does not turn in the same direction as the compass card, the two stator leads which run from synchro SG-1301 to the terminals marked S-1 and S-2 should be interchanged and the two rotor leads which run from synchro SG-1301 to the terminals marked R-1 and R-2 should also be interchanged.

h. Turn the compass card in the CBM-23AEB unit so that it indicates the exact direction in which the ship is heading and immediately reconnect motor B-1301 to the gyro system by reversing step d.

i. When it is possible to swing the ship, check to be certain that the compass card in the CBM-23AEB unit turns in the same direction as other gyro repeaters on the ship.

(1) If this is not the case, interchange the leads which run from motor B-1301 to terminals 51 and 52 in the CBM-23AEB unit.

MAINTENANCE OF DEHYDRATING UNIT

The large metal cylinder in the dehydrating unit contains silica gel, a very active air-drying agent. This silica gel absorbs large quantities of moisture from the air that is breathed in by the receiver-indicator, transmitter, and stub-supported coaxial line.

The small plastic tube mounted between the large metal cylinder and the receiver-indicator contains a special "telltale" silica gel which has been impregnated with a cobalt salt. This indicator gives a measure of the humidity in the air being delivered to the equipment. It will have a deep blue color under normal operating conditions. As the humidity of the air increases, the color changes to a lavender or light pink, which is an indication that the large metal cylinder should be removed and reactivated.

The procedure for reactivating the silica gel cartridge is as follows:

a. Remove the silica gel metal cylinder from the air hose and bulkhead.

b. Remove the "telltale" plastic tube screwed on to the bottom outlet of the large metal cylinder. (It is not necessary to reactivate the "telltale" indicator, since it is reactivated automatically when the dehydrator is placed back in service.) WARNING: The plastic tube melts at 175° F. and so will be ruined if left on the large cylinder during reactivation.

c. Place the large metal dehydrator cylinder (without "telltale" indicator) in an oven regulated at a temperature between 300° to 350° F. for from 4 to 5 hours. WARNING: Temperature of the oven should not reach 400° F. since the caps are sweated on with a solder having a melting point of approximately 400° F.

d. Inlet caps should be placed on the cylinder as soon as removed from the oven so that as it cools the breathing action will not remoisten the silica gel.

e. When the cylinder has cooled, replace on the bulkhead.

f. Remove the lower outlet cap, and replace the "telltale" indicator and air hose.

g. Remove the upper inlet cap. The unit is now ready for operation.

The indicator is your information on the condition of the replaced cylinder. It will return to a deep blue color if the dehydrator has been properly reactivated.

ATTACHING SHUNT TO M-1401

In order to protect the very sensitive movement of the echo box tuning meter (M-1401) during installation, the factory is placing a shunt across its terminals.

A tag is being attached to the tuning indicator 987 instructing the installing workmen to leave the shunt in place during installation but to remove it when all installation work has been completed.

This action is being taken because it is possible for a leaky soldering iron or even thermal-electric effect to burn out meter M-1401.

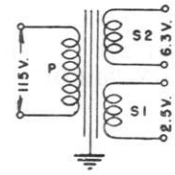
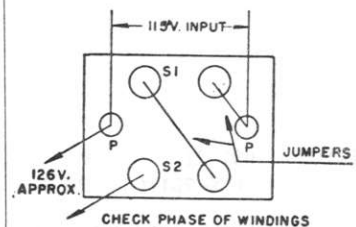
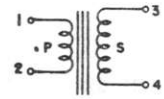
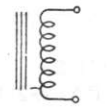
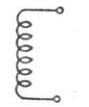
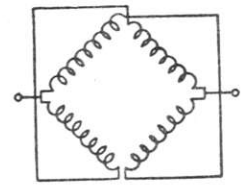
Chokes and Transformers

SF/SF-1 TRANSMITTER

SYMBOL	S. S. PART NO.	WINDING	WIRE	TURNS	RESISTANCE	RATING AND REMARKS	DIAGRAM
T-201	921-20 (UX-7010D)	Pri	17E	194 Tap 17.29	LR	115 v.	A
		Sec	32E	2610	1100	4880 v. total @ 0.09a. (3 series secondaries)	
				2610	(total)		
T-202	921-21 (UX-7011C)	Pri 1	26E	384½	4.5	115 v.	B
		Pri 2	26E	384	4.5	115 v.	
		Sec 1	16SCE	18	LR	2.5 v. @ 2.5a	
		Sec 2	16SCE	18	LR	2.5 v. @ 2.5a	
T-203	921-22 (UX-7012C)	Pri	26E	427	5.7	115 v.	C
		Sec 1	2X17E	10	LR	2.5 v. @ 5a	
		Sec 2	19SCE	27	LR	6.3 v. @ 1.5a	
T-204	921-23 (UX-7825B)	Pri	24E	453	5.7	115 v.	D
		Sec	18E	106	LR	25.5 v. @ 2.2a	
T-204 T-208	921-23 (UX-7013B)	Pri	24E	453	4.3	115 v.	
		Sec	18E	112	LR	27 v. @ 2.2a	
T-205	921-24 (UX-7014A)	Pri	22E	347	2.5	115 v.	E
		Sec 1	17SCE	8	LR	2.5 v. @ 2.5a	
		Sec 2	17SCE	8	LR	2.5 v. @ 2.5a	
		Sec 3	35E	4200	590	1390 v. (NL) Rated 0.04a	
				tap 2275	(total)	750 v. (NL)	

Chokes and Transformers—Continued

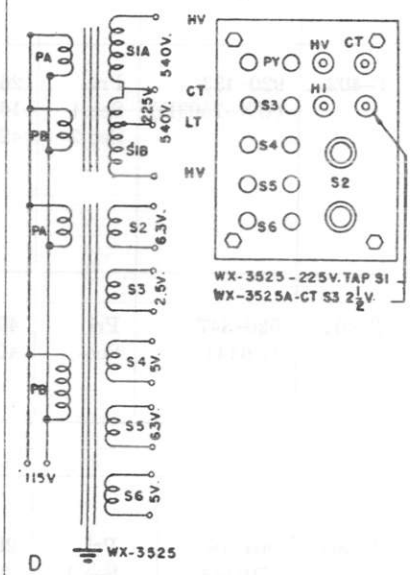
SF/SF-1 TRANSMITTER—Continued

SYMBOL	S. S. PART NO.	WINDING	WIRE	TURNS	RESISTANCE	RATING AND REMARKS	DIAGRAM
T-206	921-25 (UX-7015B)	Pri Sec 1 Sec 2	26E 16SCE 16SCE	395 9 23	4. 7 LR LR	115 v. 2.5 v. @ 2.5a 6. 3 v. @ 2.5a	  CHECK PHASE OF WINDINGS BY ADDING JUMPERS VOLTAGE SHOULD BE ADDITIVE AS MEASURED AT POINT SHOWN. F
T-207	921-246 (UX-7585A)	Pri Sec	29E 18E	346 21	9 LR	115 v. 6.3 v. @ 2.5a	
T-208	Same as T-204						
			INDICATOR				
L-405	920-350 (UX-7043)		37E	4, 550	850	10H. 0.015a	 A
L-408	920-317 (UX-7502A)		24E	1, 090	19	1.5H 0.4a	
L-406	920-211 (68G576)				100	Deflection coil	 B
L-407	920-212		38 E	48, 000	20, 000	Focus coil	 C

Chokes and Transformers—Continued

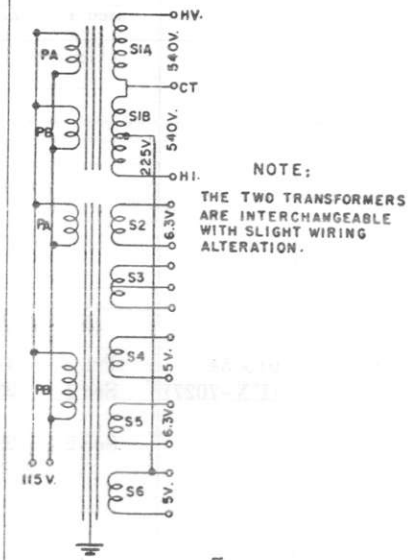
INDICATOR—Continued

SYMBOL	S. S. PART NO.	WINDING	WIRE	TURNS	RESISTANCE	RATING AND REMARKS	DIAGRAM
T-401	920-432 (WX-3525)	Pri A	18E	164	LR	115 v.	
		Sec A	25E	820	15.8	540 v.	
		Pri B	18E	164	LR	115 v.	
		Sec B	24E	380	14.5	540 v. tapped	
		--------	25E	440	--------	225 v.	
		Pri A	20E	300	1.4	115 v.	
		Sec 2	9SCE	18	LR	6.3 v. @ 14a	
		Pri B	20E	300	1.4	115 v.	
		Sec 3	11E	7	LR	2.5 v. @ 7.5a	
		Sec 4	12E	14	LR	5 v. @ 6a	
		Sec 5	20E	18	LR	6.3 v. @ 1a	
		Sec 6	15E	14	LR	5 v. @ 3a	



NOTE:-WX-3525 COMPOSED OF TWO TRANSFORMERS IN SAME CASE.

	920-593 (WX-3525A)	Same as WX-3525 except that Sec 3 is center tapped. 225 v. tap on Sec. 1 is connected internally to Sec. 6.					

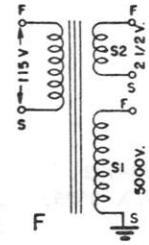
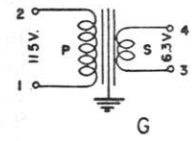


NOTE:
THE TWO TRANSFORMERS ARE INTERCHANGEABLE WITH SLIGHT WIRING ALTERATION.

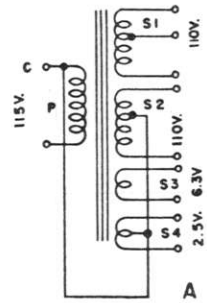
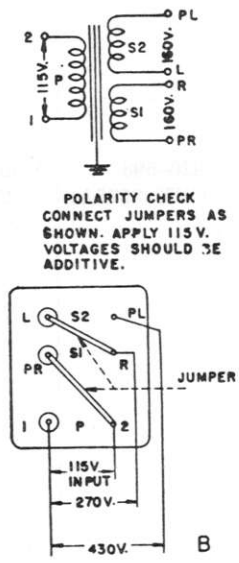
WX-3525A IS COMPOSED OF TWO TRANSFORMERS IN SAME CASE.

Chokes and Transformers—Continued

INDICATOR—Continued

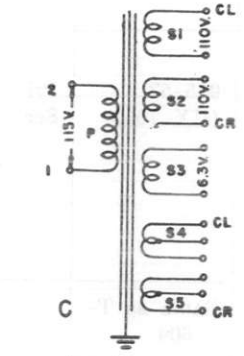
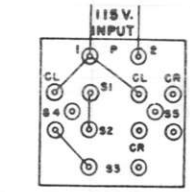
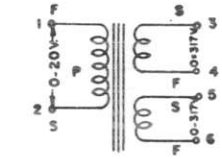
SYMBOL	S. S. PART NO.	WINDING	WIRE	TURNS	RESISTANCE	RATING AND REMARKS	DIAGRAM
T-402	920-433 (UX-7503D)	Pri Sec 1 Sec 2	26E 16SCE 42HF	370 8½ 16, 400	4. 7 LR 9, 300	115 v. 2.5 v. @ 5a 5,000 v. @ .002a	
T-403	920-347 (U6444)	Pri Sec	40E 40E	500 8, 000	165 3, 300	(Training light transformer)	

SUPPLEMENTARY UNITS

T-301	904-19 (7016D)	Pri Sec 1 Sec 2 Sec 3 Sec 4	26E 39E 39E 22E 2X17E	415½ 442½ tap 221 442 tap 221 25 10 tap 4½	5. 5 145 145 LR LR	115 v. 110 v. @ 0.01a 110 v. @ 0.01a 6.3 v. @ 1a 2.5 v. @ 7a	
T-601	915-54 (UX-7027)	Pri Sec 1 Sec 2	17E 23E 23E	188 288 288	LR 4. 3 5.	115 v. 160 v. @ 0.6a 160 v. @ 0.6a	

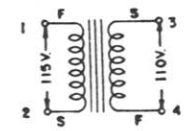
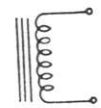
Chokes and Transformers—Continued

SUPPLEMENTARY UNITS—Continued

SYMBOL	S. S. PART NO.	WINDING	WIRE	TURNS	RESISTANCE	RATING AND REMARKS	DIAGRAM
T-602	915-55 (UX-7033)	Pri	23E	335	2.7	115 v.	
		Sec 1	26E	345	7.	110 v. @ .023a	
		Sec 2	26E	345	8.	110 v. @ .023a	
		Sec 3	17E	20	LR	6.3 v. @ 2.5a	
		Sec 4	12E	8 tap 4	LR	2.5 v. @ 7a	
		Sec 5	12E	8 tap 4	LR	2.5 v. @ 7a	
							C
							
							POLARITY CHECK CONNECT JUMPERS AS SHOWN. WITH 115V. ON PRIMARY VOLTAGE SHOULD BE ADDITIVE. P2 TO S1 ---------- 220 V. P2, S1 AND S2 ---------- 330 V. P2 TO S4 ---------- 112.6 V. P2, S4 AND S3 ---------- 119.2 V. P2, S4, S3, S5 ---------- 121.8 V.
T-603	915-52 (UX-7029A)	Pri	32E	240	9	0-20 v.	
		Sec 1	40E	3800	1450	0-317 v. @ 5 ma max	
		Sec 2	40E	3800	1800	0-317 v. @ 5 ma ma	
							POLARITY CHECK CONNECT 1 AND 3, 4 AND 5. APPLY 20 V. OR LESS TO PRIMARY. ALL VOLTAGES SHOULD BE ADDITIVE.
							D

Chokes and Transformers—Continued

SUPPLEMENTARY UNITS—Continued

SYMBOL	S. S. PART NO.	WINDING	WIRE	TURNS	RESISTANCE	RATING AND REMARKS	DIAGRAM
T–604	915–53 (UX–7032)	Pri Sec	36E 40E	1745½ 1825½	132 488	110 v. 110 v. @ 0.01a	 POLARITY CHECK CONNECT 1 AND 3. APPLY 115V. TO PRIMARY. 2 TO 4 SHOULD MEASURE 225–230V. APPROX. E
T–605	Same as T–604						
L–701	923–54 7030C		22E	358	2	0.6a	 F
L–702	Same as L–701						

MODEL SF SERIES TROUBLESHOOTING NOTES

Antenna and Control System

NATURE OF DIFFICULTY	TROUBLE FOUND AND REMEDY
There was some hunting in the antenna training system. This caused M–G set output voltage variation, which resulted in unsteady traces on both A scope and PPI.	Operation of training system was improved by adjusting R–604 and R–605 in the control rectifier. This eliminated variation of M–G set output.
The thyratron tubes V–601 and V–602 could not be adjusted to remove training error.	Found slight misalignment of antenna drive motor B–101. Aligned motor B–101 and adjusted thyratrons V–601 to obtain ½-volt a-c at terminals 3 and 4.
Doesn't rotate.	Training motor B–101, dirty brushes, damaged bearings or burned out winding. Defective K–601, S–404. Switch S–404 not being closed on automatic training—Adjust position of operating collar on training shaft; replace switch if arm is too badly worn.
Rotates erratically.	Check for improper adjustment of R–604 and R–605. Check for defective V–601 and/or V–602. SG–101 gears have "backlash." Remove the "backlash" (may require bending the selsyn mounting yokes slightly). Check for mechanical binding in training motor, B–101, or in antenna gear box. Loose or damaged coupling on B–101.
Noisy.	Check for damaged bearings in antenna gear box, loose or damaged coupling on B–101, or misalignment of B–101. If B–101 is misaligned, shim into alignment. If antenna base plate is badly sprung out of shape, remove antenna unit and reassembly with a ¼-inch to ¾-inch gasket between the antenna base plate and the mounting plate on the mast.
Wrong thyratron fires (antenna rotates in proper direction).	D-c polarity reversed at terminals at L1 and L2 in magnetic controller. (CAUTION—Make certain that polarity of d-c at ship's main power panel is not temporarily reversed by connection to "dock power" or similar circumstance.) Reverse input leads to terminal L1 and L2. Training motor B–101, field leads reversed—Reverse leads from training motor, B–101, to terminals F1 and F2 in antenna unit.
Water in antenna.	The antenna covering had not been secured tightly, allowing water to enter unit.
Antenna hunting.	Synchro gear not flush with antenna gear.
Antenna drive motor failed four times in past 2 months.	Found moisture in antenna and motor. The antenna hood had not been secured properly so that it was air tight.
Training error.	Examined all parts of antenna assembly and associated gear for reasons for training error. Reduction of rotation speed, below 14 rpm, cleared the error, indicating mechanical drag in antenna assembly. Availability was not sufficient to permit work on the antenna mechanism. Check Field Change 3.

Antenna and Control System—Continued

NATURE OF DIFFICULTY	TROUBLE FOUND AND REMEDY
The synchro SG–101 had become loose and antenna had slipped so that it was about 180° out.	The antenna synchro was readjusted and tightened into place.
Antenna training system functioning improperly.	Polarity reversed to the equipment, also synchro leads had been changed so that they were not correctly connected. After clearing up these difficulties, found that the coupling on the antenna motor to the antenna gear mechanism was loose and not effective. When this coupling was properly adjusted and tightened the system worked normally.
Polarity of d-c from ship's panel reversed, causing wrong firing of C1B thyratrons in antenna synchronizing control.	Reversed the leads coming from the ship's power panel.
Antenna drive motor runs too slowly. PPI controls had been slowed down to allow antenna to keep up with the PPI scope.	Removed the d-c driving motor from the antenna, turned the commutator, cleaned undercutting and tested, cleaned brushes, etc. This motor delivered at least twice the power after this cleaning. Brushes should be checked quarterly.
When the antenna drive was placed on automatic, a bearing error was noted, and the echoes received were stationary, regardless of the bearing indicated by the PPI.	This trouble was traced to a burned out K–601 control thermal relay in the control rectifier. It was noted that bearing error was present, due to the fact that the thyratron, C1B, regulators in the control rectifier were not firing. Continuity and voltage tests were conducted at the supply lines and at the thermal relay K–601. It was determined through these tests that the heater coil of K–601 was open, and consequently the relay contacts were not making. This prevented plate voltage from being applied to the thyratrons.
Intermittent training error indication.	Eliminated training error indication by adjustment of control rectifier.
Thyratrons stayed lit when gear was not training.	Readjusted R–604 and R–605 in control rectifier.
Wrong thyratron was firing.	Due to incorrect polarity of the d-c line from the ship's main panel the wrong thyratron was firing. Polarity was changed to correct polarity at the supply panel. This change required that R–1 and R–2 in the antenna be changed to correct positions.
The pattern of received echoes on the PPI scope kept shifting constantly.	The C1B thyratrons in the antenna control rectifier were soft.
Severe unbalance in adjustment caused severe flicker in a-c line voltage.	Readjusted R–604 and R–605.
Antenna noisy when rotating automatically.	Thyratron adjustment out of tune, causing antenna to hunt. Adjusted thyratron.
Only a few echoes could be obtained, and these echoes were present regardless of the bearing indicated on the PPI scope.	This trouble was due to a loose coupling between the antenna and antenna drive motor. Also one of the thyratrons in the control rectifier for the antenna drive motor showed an open filament. The C1B thyratron of the control rectifier was replaced. Voltage output tests were conducted on the control rectifier, and results obtained appeared to be satisfactory. The antenna hood was removed and the motor coupling securely tightened on the shaft connecting to the antenna.

Antenna and Control System—Continued

NATURE OF DIFFICULTY	TROUBLE FOUND AND REMEDY
Turning motor shaft by hand was very difficult. Universal joint seemed to be stiff and binding.	Took off universal joint, oiled it and reinstalled. Aligned motor by shimming it into free alinement.
Erratic operation of antenna train mechanism. Selsyn binding.	Selsyn bearings completely worn out. Bearings had never been lubricated.
Constant indication of training error voltage.	Found trouble due to coupling spider between gear box and motor having loosened causing failure of motor to drive gear shaft. Recoupled motor to gear box, tightening lock screws.
SG–101 selsyn mounting had backlash.	Adjusted selsyn mounting for no backlash.
Dome leaking water through a thin spot in it.	Built up thin spot in dome with paper, varnish and waterglass.
Antenna drive motor out of line due to bolting antenna assembly to uneven mounting table.	Reshimmed motor so as to obtain proper alignment.
Slight training error.	Antenna selsyn too tightly engaged to antenna gears and motor slightly out of line. This corrected and antenna training normal.
Coupling between motor B–101 and pedestal extremely noisy.	Antenna motor, B–101, shimmed to align with pedestal shaft.
Binding in gear box and coupler to motor due to base plate being uneven.	Had antenna removed and base plate levelled. Replaced antenna on a heavy canvas gasket dipped in red lead.
Constant training error was noted on training error indicator lamp I–407. Also no signals were being received except at one setting of the PPI bearing indicator.	The coupling on the shaft of training motor B–101 in antenna assembly was found to be loose and riding free on the motor shaft.
Excessive vibration during operation.	Shimmed motor, B–101 and aligned it with the gear box shaft, thus eliminating vibration.
Antenna very noisy in operation.	Shimmed motor B–101 to align with gearing and reduce noise in operation.
Constant training error as shown by training error lamp I–407.	Gear on antenna synchro was loosened and no training error was observed on training indicator lamp I–407.
Antenna would not rotate.	The motor coupling had become loose, permitting the motor to uncouple itself from the antenna shaft. The coupling was reset and tightened.
Tube, V–601, firing on clockwise rotation.	Interchanged supply leads to terminals L1 and L2.
Antenna would not rotate properly and was very jerky.	A1 and A2 were reversed. Field polarity of motor was wrong.
Trace on "A" scope, V–405, was moving when antenna was turned on "automatic."	Readjusted antenna control rectifier 915A; this cleared up the moving trace.
Left-hand thyratron V–601 firing when training control was in automatic position or when rotated clockwise by hand.	This trouble was found to be caused by wrong connections in unit 922A antenna assembly, wires to terminals F1 and F2 being reversed. After connecting these wires to correct terminals the antenna was lined up with PPI. Selsyn and antenna gears set to proper mesh.

Antenna and Control System— Continued

NATURE OF DIFFICULTY	TROUBLE FOUND AND REMEDY
Personnel stated that when equipment was put into operation at sea that 180° error in antenna training was noted. Personnel had reset antenna synchro, but noted thereafter that targets were 15° to 18° out of phase with simultaneous visual bearings.	Connector to PPI selsyn motor, S1–S2–S3 was reversed. Adjusted and realigned antenna selsyn motor to correct error in antenna direction.
Antenna not training.	Reversed selsyn generator SG–101 making antenna train properly.
Thyratrons firing incorrectly.	Adjusted thyratrons to eliminate training error and to permit antenna rotation.
Antenna spinner was rotating continuously in spite of the fact that the PPI mechanism was stationary.	It was impossible to make the right hand thyratron stop firing by adjustment of resistors R–604 or R–605. A new tube (right V–602) was installed and firing (also rotation) of the dish ceased. Further checks with the voltmeter revealed that no error voltage was being transmitted from the selsyn (SG–101) to the control rectifier at terminals 4 and 5.
PPI running approximately 2½ times faster than antenna. Antenna warning not showing.	Rotor contacts on PPI synchro (SG–401) not making contact. Cleaned slip rings on PPI synchro (SG–401).
C1B's in control rectifier firing when antenna is stationary. Transformers in control rectifier and chokes in filter unit running hot. Training error (standing).	Adjusted control rectifier for minimum error voltage, and proper firing of thyratrons.
Antenna did not rotate smoothly.	Even firing of the two thyratrons in the control rectifier when the antenna is on "automatic" rotation is the only way that smooth rotation of the antenna can be obtained.
Control rectifier 915A was not firing regularly and could not be adjusted satisfactorily.	Replaced R–601 which had increased in value from 25,000 to 30,000 ohms, unbalancing the two sections of V–603 and making it impossible to adjust the control rectifier properly. Control rectifier adjusted perfectly after replacing R–601.
Whenever either V–601 or V–602 would fire they would completely block out the radio receiver. The interference was also present on the sound receiver.	This interference was undoubtedly caused largely by the fact that none of the units of this ship were bonded at installation, due to lack of suitable bonding material. Availability was too limited to bond the units at this time so, as a temporary measure, terminals 3 and 6 in the control were bypassed to ground through 0.5 μfd condensers. This eliminated the interference completely. The units should be bonded completely as soon as availability permits.
Antenna was not in synchronism with bearing indicator, as noted by warning light.	Aligned antenna by loosening yoke, and adjusting synchro.
Antenna approximately 5° out of line with lubbers line.	Aligned antenna by loosening yoke, and adjusting synchro.
Bearings reported to be approximately 60° out.	It was found that the antenna synchro gear wheel at some time during operation of the equipment had unmeshed and then jarred back into position. The synchro was readjusted and the supporting bracket was slightly bent so that the gears would mesh more deeply.

Antenna and Control System—Continued

NATURE OF DIFFICULTY	TROUBLE FOUND AND REMEDY
About 90° angular displacement in PPI scope. Train-error indicator glowed twice each 360°.	Short in antenna synchro field. Painted field winding at end where leads went in with insulating varnish diluted thin with alcohol.
Antenna improperly aligned with respect to ship causing a consistent error on all bearings taken.	Rotated body of antenna selsyn until antenna was properly lined up with respect to ship.
Discovered training error of 30°.	Trouble traced to loose coupling between antenna and training motor. Antenna realigned and coupling tightened.
Output was low due to faulty contacts in coaxial line.	The contacts were improved by cleaning the joints and reassembling. This brought the output up to normal.
Microammeter in echo box circuit would not operate.	Sealing compound at base of 1N21 crystal would not permit spring to make electrical contact. Scraping of sealing compound and reassembly corrected this trouble.
Pink crystals in the dehydrator indicator.	Silical-gel capsules needed rejuvenating. (See *RMB* page SF 1-18.)

Transmitter Converter

V-210 McNally heater cavity would not heat, causing excessive L. O. drift.	Found thermostat screw on cavity too far out and thermostat never operated. Set cavity temperature to 225 degrees by means of the thermostat screw using Pyracon to check temperature.
Magnetron current abnormally low, causing decreased power output.	Cleared contacts on K-202, current returned to normal.
Water in wave guide.	Coupling loose at point where antenna connects.
Relay K-201 would not close.	Found that relay K-201 had dirty contacts.
Relay K-201 doesn't close.	Replace defective R-224. Check resistor in series with R-224 for correct value.
Potentiometer R-247 overheating.	Insufficient bias on tubes V-203 and V-214 (see Radar Transmitter Converter—Voltage—negative 650 low).
L. O. cavity cold.	Heater open—replace. Thermostat defective—replace.
Continuous arcing within tubes V-203 and V-214.	Replace V-203 and V-214. Check V-201, V-202, and V-204.
Arcing within rectifier crystal cavity.	TR tube V-211 defective—replace.
Magnetron current nonexistent.	Check M-201, if defective, repair or replace. Check V-205, V-201, V-202, V-203, V-204, V-214, R-247, C-203 through C-206, and L-201.
Magnetron current high.	Check for defective meter M-201, damaged transmission line, water in transmission line, defective magnetron, or weak magnet.
Magnetron current low.	Check for defective meter M-201, defective magnetron, defective R-206. If no results, check V-201, V-202, V-203, V-204, and V-214.
Unstable magnetron current.	Check for defective magnetron, meter M-201, improper seating of magnetron, arcing in coaxial line, components V-201, V-202, V-203, V-204, V-214, C-203 through C-206, C-213, and L-201.

Transmitter Converter—Continued

NATURE OF DIFFICULTY	TROUBLE FOUND AND REMEDY
No crystal current.	Check for defective crystal Y–201, defective L. O. V–210, and improper tuning of cavities.
Crystal current high.	Defective meter M–201, improper adjustment of R–506. Readjust R–506 to obtain the low voltage *mode* on the L. O. tube.
Crystal current low.	Defective meter M–201, defective rectifier crystal Y–201, defective L. O. tube V–210 or improper tuning of L. O. cavity, and L. O. coupling loop open.
No crystal current on meter M–201 in unit 921C.	On checking the 1N21 rectifier crystal (Y–201) in the converter section of unit 921C it was found to be defective (burned out). It was replaced and the new crystal immediately burned out indicating too much radio frequency input to the mixer. This was found to be due to a defective tube V–211 in unit 921C. When this tube was replaced and another 1N21 rectifier crystal (Y–201) installed, the crystal current on meter M–201 was normal as was also the operation of the equipment.
Crystal current low but radar operating normally. Current approximately 0.1 ma.	Slight readjustments to V–210 cavity raises current to 0.6 ma.
Lack of crystal current on transmitter-converter unit and lack of range on operation.	Found local oscillator tube 707A was defective so that its output was very low. Changed tubes, tuned L. O. cavity plugs. This brought crystal current to normal and range was brought up to normal.
Crystal current was higher than normal and it was found that maximum signals were not obtained at maximum crystal current.	Tuning of the cavity of local oscillator (V–210) remedied this trouble. Crystal current was then normal with a maximum occurring at a point of maximum signals, without undue sharpness of tuning.
Low crystal current on meter M–201.	Adjusted coupling between McNally cavity and crystal cavity for correct crystal current.
Crystal current would drop after a period of time.	Replaced McNally tube V–210 with 707B tube, retuned cavity and crystal current was steady, regardless of how long unit was in operation.
Crystal current too high.	Retuned McNally cavity for correct crystal current, also for maximum echoes with least noise return.
Excessive crystal rectifier (Y–201) current.	Reduced crystal current to safe level by tuning and adjusting Y–201 cavity.
Found no perceptible crystal current reading on crystal current meter, although echoes were being received.	This was due to beating oscillator being tuned to wrong mode of operation.
Very low crystal current regardless of tuning of oscillator cavity and increasing the coupling. Overall poor performance of equipment.	Replaced V–210 (707A) from ship's spares.
Crystal current too high.	Adjusted coupling between L. O. cavity and TR cavity for proper crystal current.
Local oscillator cavity out of tune.	Returned local oscillator cavity by means of plugs.

Transmitter Converter—Continued

NATURE OF DIFFICULTY	TROUBLE FOUND AND REMEDY
Radar man aboard ship *bends flanges* on McNally tube because it is difficult to insert. This chips glass away from the seal in the tube when clamped in the cavity. In doing this they had used all their spare tubes of this type. Also the cavity has been damaged by *wrong-size screwdriver* and tuning screws are in bad shape.	The McNally tube is hard to purchase. Therefore it should be handled with care. *Patience* may save a tube for a buddy that hasn't any tubes. The cavity should not be tuned under any circumstances without the proper size screwdriver.
L. O. tuning knob has no effect.	Spring connector to V–210 cap bent to make proper contact.
Used four 707A's in 14 hours of operation.	Inspection revealed that the coupling loop in the McNally cavity was unsoldered.
Frequent failures of 707A tubes.	It is very possible that the 707A tubes can be ruined if the lid or front of the receiver indicator is opened with the unit operating. In this case if the lid is opened and a minute later the interlocks are again closed this will allow about 450 volts to be placed on the cavity of the 707A tube and in this case the tube does turn a bright red. This is due to the fact that until the entire load is placed on the tubes of the receiver the voltage remains very high. The rectifier and regulator tubes are of the filament type while the other tubes are of the heater type and require some 30 seconds to heat up.
Thermostat on cavity heater not functioning, causing cold cavity.	Thermostat on cavity heater corrected by adjustment of screw on side.
The frequency of the local oscillator was drifting during operation of the equipment.	Open heating element.
L. O. (V–210) cavity was heating very little. The d-c voltage across the heater element when the thermostat was closed was only 55 volts. As a result the L. O. was drifting badly.	Dismantled thermostat, dressed contacts down and readjusted it. L. O. cavity heated O. K. after this and no longer drifted.
Frequency of McNally cavity unstable due to low adjustment of heater thermostat. Operational temperature of cavity would exceed the temperature the unit was set for, causing drift.	Adjusted thermostat so that optional temperature was below the normal temperature maintained by the cavity. This was done by increasing the temperature setting of the thermostat.
RK707A drift caused by heat. Crystal cavity out of tune.	Found thermostat burned out. Retuned crystal cavity by means of plug and locked with locking ring.
Equipment reported inoperative after burnout of several 1N21 crystal rectifiers.	721A tube V–211 was cracked, defective. This defective tube was undoubtedly the cause of drystal burnouts which were reported. Replaced tube.
Erratic local oscillator tuning. Unable to keep in tune. When properly tuned had crystal current 0.2 milliamps which would gradually decrease to 0.0 and local oscillator required retuning.	Paralyzed Y–201, 1N21 rectifier crystal, loss of rectifying property.
PPI trace faded.	Changed crystals in rectifier; unit operating satisfactorily.
Time delay thermostat closed in about 5 minutes, the proper time delay being 2½ to 3 minutes.	Reset the time delay thermostat.

Transmitter Converter—Continued

NATURE OF DIFFICULTY	TROUBLE FOUND AND REMEDY
The time delay circuit on the pulser would not function.	The pigtail lead connecting to the armature of relay K–201 was unsoldered at the armature.
Relay K–201 friction in hinge.	Removed friction in hinge of K–201 with slight wipe of oil and operation by hand.
Relay K–202 friction in hinge and movable arm out of alignment.	Straightened position of movable arm, wiped the hinge bearing with oil, operated by hand until friction was removed.
Relay K–201 failed to operate in Transmitter Converter Unit 921C.	Heater resistor on relay K–201 was open. New heater installed. (Base spares.)
High voltage would not kick in.	Relays K–201 and K–202 found to have dirt film on contacts. Cleaned with crocus cloth.
On checking, it was found that there was no voltage on relay K–201.	Further checks revealed a broken d-c voltage lead in the A box. (Junction Box A.)
Relay K–202 not closing properly; would not come in by itself.	Throw of relay reduced to make it close properly.
Interference on scope images caused by blower motor commutators.	Transmitter cover removed and motor brushes and commutators polished and cleaned.
Considerable hash on screen of scope tubes was caused by blower motor noise.	Made Field Change 40 with blower filters.
Blower motor brushes were not seating properly, causing interference, jumpy trace on "A" scope V–405 in receiver-indicator and causing "snow" effect on PPI.	Removed blower motor brushes and sanded down the edges of them and reseated them. This cleared up the interference.
Arcing the blower motor B–202 was causing interference on scopes.	Cleaned commutator on blower motor B–202.
Input to transmission line O. K., but not able to obtain a spark at the antenna.	During the process of assembling the transmission line a bullet had been split. This caused an arc from the bullet to the outer conductor. There was solder on the outside of the inner conductor.
Lack of echoes, although everything seemed to be normal otherwise.	Found about a quart of water in the antenna coaxial line which was shorting out the line. Evidently this water came into the line during installation but was so evenly distributed that it did not short out the line until after the ship had rolled enough to cause it to accumulate in one end of the line. Trouble was cured by taking line apart, removing all water, allowing to dry and carefully reassembling again. Left equipment operating very satisfactorily.
Low radiation from antenna. Ringing time 5500 on 7500 echo box.	Found layer of paint on face of compression coupling joining two sections of coaxial line 20 feet from transmitter. This was thoroughly cleaned and assembled bringing up the ringing time to 7400.
Loose bullet from first elbow of coaxial line.	Spread bullet from first elbow of coaxial line to insure positive contact.

Transmitter Converter—Continued

NATURE OF DIFFICULTY	TROUBLE FOUND AND REMEDY
There was too much arcing in transmitter—so much that it was not possible to keep it running.	Found voltage output from motor-generator to be over 160 volts a-c—checked speed and found it far above normal. Checked speed regulator—found one brush badly worn and much dirt and accumulated dust on the speed regulator. Cleaned regulator—installed new brush and adjusted regulator to obtain proper speed and voltage was then normal.
High voltage was arcing across inside the pulser unit and there was no transmitter current. There were no sweeps on the scopes in the operate position of the controls.	The arcing in the pulser unit was due to three causes as follows: The voltages were building up above normal due to no load on the rectifiers. The RX–233A tube was cold and was not pulsing. A new tube was installed. The insulators were dirty and were cleaned. After the pulser unit was made to fire by the installation of a new RX–233A there were normal sweeps on the scope tubes.
In the transmitter converter the magnetron was arcing at the base causing a fluctuation of current.	The tube was reseated, and remedied this condition.
Tubes V–203 (715A) and V–214 (715A) running hot.	Grid bias to these tubes was too low (260 volts negative instead of 600 volts negative). The low bias voltage was due to a defective RKR72 tube V–206, which was replaced.
When power was applied to the transmitter, all filaments would light but the magnetron current remained zero.	No high voltage was present due to a burned-out resistor (R–247) in series with the primary of the high voltage transformer. The resistor R–247 was burned out when C–209, a 0.25 μf capacitor became shorted. The shorting of this capacitor removed the negative grid bias of 500 v., and the 800 v. screen bias from the keyer tubes V–214, and V–203. These tubes then drew excessive current, burning out R–247. A new R–247 variable resistor was installed. This restored the high voltage. With high voltage restored, and with plates of the keyer tubes not connected, R–247 did not burn up, as no excessive current was being drawn by the transmitter circuit. The bias of the keyer tubes was then measured and the trouble traced to C–209. A new C–209 capacitor, located in the cathode circuit of the square wave generator, was installed. The shorting of this capacitor, grounded the 500 v. bias supply, removing the negative bias from the keyer tubes.
No transmitted signal; erratic sweeps on scopes.	Found no trigger pulse to the transmitter due to a shorted 0.004 μf mica capacitor C–202 in the cathode of the pulse generator tube (RK–233–A) in the transmitter. This was replaced and still no signals. The 715–A tube was found to be no good and was replaced. Operation was then erratic and the output voltage of the 400-cycle generator was found to be out of control. After this was corrected the transmitter functioned well except for needing adjusting.
Couldn't lock the recurrence frequency in with the 400 cycle a-c line by adjusting R–210.	Replaced V–201 and V–202.

Transmitter Converter—Continued

NATURE OF DIFFICULTY	TROUBLE FOUND AND REMEDY
Equipment had no trace when set on OPERATE and no magnetron current. Everything in order on CALIBRATE.	Transmitter was inspected for lack of drive and one of the capacitors in the pulse forming network was found to have a megohm short (C–207). The capacitor was replaced and the unit operated in normal fashion.
Echoes disappeared in approximately 3 minutes. Disappearance of echoes accompanied by excessive magnetron current and overheating of high voltage rectifiers.	It was determined that the 715A tube, V–203, was oscillating after sufficient time had elapsed for it to heat. Replacing this tube cured the trouble. Following this correction the operation of the equipment was checked and found to be highly satisfactory.
Erratic operation of sweeps and "Magic Eye" and greatly fluctuating magnetron current.	Corrected by adjusting R–210, changing bias on oscillator, V–201.
After about 30 minutes operation, plate of V–203 (715A) would get red hot and draw heavy current and blow fuse F–201. Looked as if grid of V–203 was being held positive.	Found to be defective 715A.
Bias on the 715A's down to near 100 volts.	The leads connecting the trigger pulse into the receiver indicator were found to be crossed in the IFF junction box No. 925. This grounded the pulse.
Radar would operate normally for 5 minutes after being placed in operation and then both oscilloscopes would flare up and intensity could not be controlled by proper intensity controls.	McNally reflector voltage supply would drop in voltage due to machine screws which hold McNally cap spring in place shorting reflector voltage to the transmitter frame.
Double and erratic trace appears in range step when set at approximately 1,000 yards on short range. Long range O. K.	Clipper tube, RKR–73, V–204, replaced from ship's spares.
Transmitter-converter plates of V–208, V–209 heated red hot, blowing fuses F–201 and F–202.	Transmitter-converter low voltage power supply found shorted at junction of R–217 and R–219 to junction of C–204 and C–205. The wire connecting C–204 and C–205 was removed from below panel and placed on top.
High-voltage bus under pulser cover loose; nut on C–213 was nearly off its post.	Loose nut on C–213 tightened.
Ship complained of excessive heat in transmitter converter.	Advised ship to refrain from laying various articles on top of transmitter converter, so that heat radiation could be accomplished. When insufficient ventilation is available, emergency bracket fan should be used to blow air on the unit until Yard availability, then it should be called to RMO's attention.
V–205 (magnetron) current only half of normal.	Located open 20 ohm resistor R–217 in plate circuit of one half of V–202 (829) tube. Replaced with new resistor.
Magnetron drawing excessive current.	Readjust generator voltage.
V–205 will not draw enough current.	Found one of the leads off the cap of tube V–202; replaced this lead and adjusted LO tube and pot, R–210 and variable resistance R–447.
No magnetron plate current and potentiometer R–247 running very hot.	Trouble traced to grounded plate leads to discharge tubes V–203 and V–214 (715A's). Plate caps had been removed by operating personnel, and they had neglected to replace them before starting equipment. Replaced plate caps on 715A.

Transmitter Converter—Continued

NATURE OF DIFFICULTY	TROUBLE FOUND AND REMEDY
Magnetron current very erratic after being placed in operation 1 to 5 hours.	Replaced magnetron V–205. Frequency did not shift after several hours of operation.
There was no magnetron current although there was sufficient pulse to trigger the receiver indicator unit.	Found capacitor in pulse forming network C203 had 500,000-ohm leakage. Replaced from ship's spares.
Improper current on V–205.	Adjusted R–247 for proper current on V–205.
Low magnetron current as shown on meter M–201.	One plate lead to tube V–202 found to be off and hanging free.
Magnetron current very unsteady.	Took out magnetron tube and reinstalled so that it was centered correctly in its seat and mounting and did not touch the inner conductor of coax or its seat.

Receiver-Indicator

High gain vertical distortion resembling an unsynchronized 60-cycle sweep on "A" scope, very irregular jumpy trace on PPI scope.	The 110-volt a-c/d-c converters for ship's receivers were introducing an a-c component into the ship's main d-c power line. Inserted a 50μf capacitor in the d-c input line to the converters, from positive side to ground.
Sweeps unstable when on automatic train.	Adjusted control rectifier for smooth operation. Heavy thyratron pulses caused sweeps to become unstable.
Half sweep on both scopes.	Adjusted variable resistor R–504 in receiver indicator. This corrected voltage.
Jumpy traces on scopes.	Cleansed slip rings on motor generator and adjusted brush arm for proper tension.
Spokes on PPI scope caused by the d-c voltage being too low.	Adjusted same to 115 volts.
Unit not operating but all other units appear normal.	Check F–401 and/or F–402. Check interlock switch S–406A and/or S–407A. Insure that cabinet cover and panel are completely closed. Examine unit for broken or unsoldered leads.
Improper focus on range scope.	Check for defective scope tube V–405, defective potentiometers R–446 and R–449, resistors R–442, R–443, R–447, R–448, and R–450.
Intensity low on range scope.	Check for defective scope tube, defective potentiometer R–455, and resistor R–456.
Faulty horizontal adjustment on range scope.	Check for defective scope tube, defective potentiometer R–444, resistor R–454, and V–422 (tube and socket).
Faulty vertical adjustment on range scope.	Check for defective scope tube, defective potentiometer R–445, resistor R–453, and V–422 (tube and socket).
No sweep on range scope.	If accompanied by wide trace on PPI—one end of resistor R–526 is probable shorting to leads in nearby cable, increase clearance between resistor and cable.
L. O. tuning—potentiometer R–506 doesn't control tuning.	Defective R–506, V–210. Repeller voltage shorted to ground—Check repeller contact clip and bolts; check line between indicator and transmitter units; check C–455 and replace if necessary. Check for open R–507.

Receiver-Indicator—Continued

NATURE OF DIFFICULTY	TROUBLE FOUND AND REMEDY
L. O. tuning—potentiometer R–506 must be constantly readjusted.	Check V–210 and V–205. Retune L. O. cavity.
No sweeps when switch in OPERATE position. Short in coax from L–403 to P and J–406.	The above trouble was caused by pushing the receiver indicator into its case without arranging the cables in the back of the set. This trouble was caused by only carelessness in pushing the indicator in and out of the case. Equipment left in good operating condition. Replaced coax.
Slight "hash" and CW modulation on RAO–2 receiver.	Replaced two 6SN7GT tubes and adjusted training error on radar. This stopped all interference.
Violent oscillation with receiver gain at low levels.	Coax connectors were found to be loose, and outer conductor of coax going to plug P–403 was broken entirely off.
Unit very hot; thermometer shows temperature above 120° F.	Emergency ventilation was set up. Used bracket fan to blow air through louvers on side of unit. Ship should get in touch with RMO on first availability to get adequate ventilation to keep temperature below 120° F. (50° C.) inside the unit.
Range scope vertica. centering slightly out of adjustment.	Adjusted vertical centering by means of R–445.
A small vertical jitter was present.	Corrected by adjusting the load voltage in the thyratron regulator control.
Interference from blower motors.	Capacitor added to d-c terminals to blower motors to eliminate receiver noise which was very severe. Two 0.01 μf each side of line to ground and 0.25 μf hot side to ground curing trouble. See Field Change 40.
In unit 920A, the receiver-indicator, it was noticed that the images on the A scope tube V–504, would jump each time the antenna control drew power.	This was found to be due to voltage fluctuation present because of the length of the cable from the motor-generator unit 902C to terminal box B. This was remedied by connecting the antenna control unit 915A, wires 2RER20 and 2RERR020 to two spare wires in terminal box B which were connected to 2RER20 and 2RERR20 in terminal box A so that the load was divided and the voltage drop reduced to a satisfactory amount on the DHFA–9 cable between the two boxes. A note was left in terminal box B to indicate the changes. With this correction the images were very steady on the tube, V–405, in unit 920A.
Loss of sweep on range, cathode ray tube.	All connections on back of range scope loose. The base of the 5BPI range scope had not been soldered. Replaced the 5BPI range scope.
Targets at short ranges fall off the screen of V–405.	Centered image on V–405 by means of R–444.
The image on the range scope, particularly the range step, was very unstable which suggested a poor range gate tube (V–401).	The trouble proved to be an inoperative C1B tube in the voltage regulator which allowed the a-c voltage to drop to about 80. Replaced the C1B from ship's spares, tuned entire equipment.

Receiver-Indicator—Continued

NATURE OF DIFFICULTY	TROUBLE FOUND AND REMEDY
Position of trace on range scope unstable, sometimes appearing toward top and other times toward bottom of screen.	Replaced tube V–401.
"A" scope very dim—once in a great while it will appear bright as it should be.	Replaced "A" scope tube V–405. Trace was again as bright as it should be.
"A" scope intensity control did not function, the scope was on full brilliancy all the time.	C–451 was grounded. Replaced it.
Found trace on range scope V–425, not sweeping horizontally.	Replaced tube V–409, which was shorted.
Stability of trace, especially on the range scope, was so poor as to render radar useless.	In Converter and Range Plan Position Indicator, 920A: The triple-section capacitor (C445) was improperly connected, causing oscillation of the i-f circuits. Reconnected.
Slight indication of regeneration on "A" scope.	Adjusted potentiometer R–405 till trace on screen stabilized.
"A" scope not properly centered.	Centered trace by means of R–444.
In the Radar Transmitter Converter 921C—intermittent operation of preamplifier as indicated by periodic disappearance of signals and grass from "A" scope in 920A.	Intermittent operation of preamplifier due to faulty 6AC7 in V–212. Replaced with new tube from ship's spares.
Considerable fluctuation of the magnetron current on M–201 and of the signal on V–405.	Reset the a-c voltage to 115 volts. Adjusted the recurrence frequency control R–210, to lock in with the 400-cycle supply.
Occasional erratic and unstable images were noted on "A" scope tube caused by vibration due to improper base clamping of this tube.	Adjusted base clamping of "A" scope tube V–405 to hold more firmly in place and thus prevent erratic and unstable images due to vibration.
Amplitude of signal on range scope fades until only the trace is left; gain control has no effect; range dial light flickers.	Suspect voltage failure. Upon removing receiver indicator unit we found that a terminal screw on the 6.3-volt filament supply was loose. After tightening screw equipment operated normally.
It has been found that the sweep gate tube, V–402, can cause the image on the range scope to become jittery in a horizontal plane.	This condition has been detected in quite a few units and, at times, it has been necessary to try 5 or 6 different tubes before the image became steady.
Range step jumps.	Clean and adjust contact finger on R–406.
Erratic and expanded sweep on "A" scope.	Panel E–406 replaced with paper-base panel made at K. West.
Triple traces on the "A" scope and a great deal of noise on the scopes.	Cleaned brushes on the PPI motor which cleared up triple traces and noise. These only occurred while the antenna was being trained.
Traces on range scope tube V–405 unstable.	Measured the 300 volt supply and the voltage 310; adjusted R–504 which stabilized the traces.
Very short sweep on "A" scope V–405 due to resistor R–428 changing in value.	Replaced resistor R–428 which brought sweep to proper length.

Receiver-Indicator—Continued

NATURE OF DIFFICULTY	TROUBLE FOUND AND REMEDY
The range scope was inoperative.	This was found to be caused by an open ground connection on R–455; this so affected the bias on V–405 so that it was inoperative. This was repaired.
Image on the range scope very jittery in the horizontal plane.	This trouble was found to be due to the characteristics of the sweep gate tube V–402 (6SN6GT).
Signal strength low on V–405.	Coupling in mixer, Y–201, from TR set too loose.
Signals on V–405 intermittent.	Found coupling loop in V–210 cavity loose and bent.
Image on "A" scope was almost off the side of the scope. Horizontal adjustment had no effect.	Found trouble caused by a cut wire running between the horizontal plate of V–405 and R–454.
Range scope sweep vibrating from left to right for about a half inch with corresponding disturbance in PPI. Magnetron current was abnormally low; even when R–210 was set to maximum, the magnetron current read below 4 ma.	A-c line voltage was too low (about 90 v. ac). Readjusted R–301 until a-c line voltage was about 117 v.
Operator noticed a slight flicker, antenna training lamp and also jittery A scope at intervals.	Brushes on PPI deflection coil L–406 removed and thoroughly cleaned and freed in sockets.
Erratic pulsing on range scope on 16,000 yard range.	Eliminated by adjusting R–504.
"A" scope unstable due to blower motor noise.	Cleaned blower motors to eliminate unstable sweep.
Changing focus control R–449 caused double images on "A" scope.	Put in new scope tube (1802 PI) V–405.
Erratic sweep on tube V–405.	Found loose base on tube, V–405. Replaced tube from ship's spares.
Multiple and intermittent trace on tube V–405. This trace was jumping vertically over a range more than the full face of the tube.	Located intermittent leakage in mica condenser C–420. The resistance of this capacitor varied from infinity to 700,000 ohms. Replaced capacitor from ship's spares, thus restoring normal sweep to both scopes.
Found that there was a double trace on the "A" scope and that the sweep was oscillating.	Removed a 6SN7 tune from the socket of V–413 which must have been installed in error.
The receiver indicator "A" scope would jump each time the antenna control would draw power.	Found voltage fluctuating at antenna control unit due to voltage drop in cable between junction box A and B. Ran in new DHFA4 cable and paralleled it to terminals Nos. 1 and 8 in terminal boxes A and B. Trouble cleared.
"Dogears" on pips.	C–494 had not been changed to 0.005 μf when R–584 had been changed to 500 ohms.
Sweeps short on "A" scope.	Adjusted sweep lengths by means of C–464, C–465, and R–556.
Found the sweep shifting irregularly on the PPI tube, due to dirt or oil on brushes or commutator of PPI sweep coil.	Cured by cleaning brushes and commutator with carbon tetrachloride.
There was a slipping of PPI training mechanism on manual training.	Adjusted bushings and mechanism to eliminate this error.
Trace on PPI screen very jagged. Brushes were squeaking very badly.	Brushes were very rough, uneven, and still had original cutting grooves on surface. Slip rings were very dirty as a result of the consequent arcing. Filed contact surface of brushes, then smoothed them with crocus cloth. Cleaned slip rings with a clean cloth.

Receiver-Indicator—Continued

NATURE OF DIFFICULTY	TROUBLE FOUND AND REMEDY
Erratic sweeps on PPI scope and erratic signals.	Erratic sweep on PPI scope was due to a bad 6SN7 tube V–409. The erratic return signals were found to be due to poor control of the repeller bias on the 707–A tube. Found that the repeller bias potentiometer R–506 was worn out and all resistance variation was in some 10° at one end of the rotation. This potentiometer was replaced with an identical unit from stock. Signals were then found to be quite stable.
PPI sweep several degrees off center, and PPI not installed properly.	PPI tube V–412 properly secured in training mechanism and adjustments made to L–406.
Flashes on PPI scope like wheel spokes.	Commutator slip rings on PPI dirty.
PPI failed to focus properly.	Defective potentiometer R–497 replaced.
There was no sweep on PPI.	Tests showed open cathode circuit in V–411. Inspection disclosed a screw had become loose on capacitor case which grounds this circuit. Bolt and nut replaced and secured and operation of equipment returned to normal.
PPI does not work properly.	Found V–410 just 180° out of place in the socket. Replaced in socket.
Considerable pounding and bumping in PPI gear assembly when training control was on automatic.	Cleaned metal particles out of gears and bearing guides.
Training clutch slipping.	PPI mechanism removed and new motor switch installed. Clutch adjusted.
PPI trace not centered.	Trace on PPI tube centered by loosening screws on PPI focus coil L–407 and adjusting trace with slewing motor running. Final adjustment with clamp holding base of tube.
PPI scope not properly centered	Centered trace by means of R–478.
PPI scope pointer rubbing on glass.	Adjusted tube properly by means of bolts on yoke.
Found trace on PPI scope approximately 30° out of line with pointer.	By means of small pinion gear driving PPI mechanism, aligned trace with pointer and tightened lock screws.
It was impossible to center the PPI image (tube V–412) by adjustment of the clamp at the tube socket.	It was necessary to readjust the focus coil (L–407). When this was done, focusing was correct.
PPI scope would not give intelligible signals at low ranges.	On the PPI scope (V–412) it was found that the sweep was beginning about one-eighth inch before the center point making a bright spot about one-fourth inch in diameter when rotated. This was due to not being centered.
Erratic operation of PPI motor. When switch S–404 was closed motor would give intermittent performance, sometimes refusing to run and sometimes running below normal speed. Upon the next closing of the switch normal operation would result.	The entire system was checked for ground and for loose connection in d-c circuits, when erratic condition was present. F–404 was found to be arcing due to loose fuse wire. This was intermittent. The fuse was replaced with nonrenewable type.
Pattern on PPI tube off center.	Centered pattern on PPI by adjusting position base of tube.
Snowflakes on PPI screen.	Snowflakes on PPI were found to be caused by dirty brushes and rings. This was probably due to excessive lubrication of gears in this vicinity. Rings were cleaned and smoothed. Operation was then normal.

Receiver-Indicator—Continued

NATURE OF DIFFICULTY	TROUBLE FOUND AND REMEDY
Spokes on indicator PPI.	Wrong connection of cathode of V–412 pin No. 7. Pin No. 7 of V–412 should be connected to pin No. 11 of V–405. Transmitting pulses not synchronizing with 400-cycle a-c frequency. Adjusted R–465. Clean scope slip rings with carbon tetrachloride.
Nonlinear trace on PPI.	Check voltage across L–406 with V–408 removed. Between 1 and 2 volts. Check R–492 and R–566. Total 550 ohms. See that C–462 is removed.
Large minimum range circle which cannot be reduced by PPI centering control.	L–405 open.
PPI intensity control has no effect, with intensity of tube at full brilliance.	C–441 grounded or shorted.
Trace (PPI) jumps toward center of scope causing a line across scope. Ragged inner circle.	Dirty slip rings. Clean with carbon tetrachloride.
Switch S–404 which is operated by the Manual and Automatic Training control was not throwing because it had come loose.	Same was properly set and tightened and then normal operation resulted.
PPI drive shaft sticks.	PPI drive shaft removed and straightened. Assembly cleaned and oiled.
Blower motors B–201 and B–202 921–10 sparking at commutator and causing interference on PPI.	Cleaned and polished commutators and installed Field Change 40.
PPI motor speed too high.	Installed a 1000-ohm, 10-watt resistor in series with R–562 to reduce rotational speed of PPI motor.
Sweep on the PPI not sweeping the full length of the scope tube.	Cathode resistor R–492 was checked and found to be 550 ohms.
Slewing motor, B–401, fails to operate when training handle is pulled out.	Collar on training handle which operates switch S–404 had loosened. In addition, the switch handle had worn flat on one side so that the clutch was not engaged when training handle was pushed in for normal training.
Ball bearings holding PPI ring gears were loose on gears.	Adjusted bearings holding ring gears.
Range pointer rubbing on PPI tube.	Moved the PPI tube back farther in its mounting.
The shaft to the operators training wheel would bind when placed in the MANUAL position. When in the automatic or motor drive position the operation was normal.	The trouble was traced to a bur on the shaft, which caused the shaft to bind in its bearings.
Large black spot in center of PPI and could not center PPI with the centering control potentiometer.	Found L–405 open, which upset the PPI centering control. Replaced L–405.
Automatic training motor fails to drive when placed on automatic. This happens periodically and corrects itself when secured for a period of time.	Bearings oiled and adjusted on PPI assembly. Reduced frequency of occurrence or trouble.
PPI V–412 sweep length very short and could not be controlled or adjusted by any setting of R–556.	Replaced burned out resistor R–494.
Intensity of PPI tube was excessive.	Made Navy Field Change 28 (cut out R–489).

Receiver-Indicator—Continued

NATURE OF DIFFICULTY	TROUBLE FOUND AND REMEDY
Short sweep on long range position on PPI scope.	Adjusted controls C–464, C–465, R–478, and R–556 for proper PPI centering and sweep length.
Sweep on PPI tube V–412 too short.	Adjusted R–556 for proper length of sweep on PPI.
Unable to focus trace on PPI.	Cleaned the face of V–412 (1812P7) with lens tissue. It had collected soot from the oil burners to the extent that the operators were unable to focus the trace.
Trace on scope tube V–412 became very faint after a short period of operation.	Found capacitor C–456 leaky. Resistance, 250 ohms. Replaced same from ship's spares, restoring trace to tube V–412.
PPI motor would not rotate	Replaced brushes in the PPI motor, oiled and tightened the assembly.
Unable to properly center PPI trace. Large blank spot about three-fourths of an inch at beginning of trace. Unable to make this any smaller at sny setting of PPI centering control R–478.	L–405 found to be open. This was replaced from tender spares.
PPI focus control goes out of range as equipment warms up.	Made Field Change 23 (changed R–496 to 4000-ohm BT–2).
Very poor definition on PPI scope when receiver gain is set for more than one-eighth inch of "grass" on "A" scope.	The shaded areas were found to be coming from the receiver unit. The trouble was then traced to a 6AC7 (in the second i-f stage), which was replaced from ship's spares.
End of range about one-third of sweep off the PPI.	Adjusted R–556 so that PPI trace was fully on tube face.
No signals in either receive or calibrate position, although grass present and everything seemingly normal.	Found R–584 burned out. Replaced same and echoes being received very satisfactory. Found imperfect connection between tube pins and socket pins on tube V–407. When adjusted the calibration signals were normal and the equipment was operating satisfactorily.
No signal, just line, no grass.	Resistor in 6V6 cathode circuit of i-f strip burned out. 6V6 tube bad. Burned out resistor to screen grid voltage supply. Cable connection from i-f strip to indicator soldered connection bad or broken.
Found spurious images on scopes and discovered this was due to pickup in preamplifier wiring.	This was cured by grounding the case of filament transformer T–207.
Erratic operation of both scopes when on OPERATE.	Lead to trigger plate next to C–213 had broken off. Cured by better solder joint.
No video signals, but otherwise normal in operation.	No video signals were being received as the cathode condenser of the first video amplifier had been shorted out apparently due to the operating heat of the tube and the load drawn.
The screens of the cathode ray indicators showed only a spot of light due to lack of sweep voltage.	This trouble was due to a nut being lodged against the sweep generating capacitor, thereby grounding the sweep voltage to the frame. Removed nut.
Loss of sweep on range scope and PPI which jumped with vibration.	Broken filament in the sweep gate tube (V–403 6AG7). Replaced tube.
When the equipment was placed on OPERATION, no video amplifier signals or grass was evident. Also the second video amplifier V–434 showed signs of burning up.	The circuit components of V–434 were measured, and C–493 found shorted. The screen resistor showed a lower resistance than normal so that both were replaced. A new 6L6 was used for V–434 to replace the damaged tube.

Receiver-Indicator—Continued

NATURE OF DIFFICULTY	TROUBLE FOUND AND REMEDY
Unstable sweep and intermittent signals.	Fluctuating line voltage was determined to be the cause of failure. Inspection of the machine showed erratic operation traced to a bad governor. Damage to the governor had been caused by an intermittent contact on the field resistor R–802. This intermittence caused the entire field current of the machine to flow through the governor. The contacts were badly pitted and the brushes burned The contact was resoldered and the governor cleaned and repaired.
No sweep on either scope.	Since the sweep had been disappearing momentarily each time depth charges were dropped, complete failure occurring with a particularly severe detonation, a mechanical fault was suspected. A solder sprue on the terminal of C–407, adjacent to the plate of T–402, had shorted to the case which is at ground potential. Further trouble then developed, of a similar nature, which could be cleared by removing V–404 from its socket. A new tube was installed and the trouble cleared.
Trace had a very bad flashing.	In preamplifier, bypassed the filament, B plus and meter lead.
Instability of the images on the "A" and PPI tubes.	The receiver-indicator, tube V–416, 6SJ7, was found improperly inserted in the socket so that the voltage regulator circuit consisting of tubes V–416, V–421, V–414, V–415 and V–436 did not function properly. Inserted V–416 properly.
No horizontal sweep on range or PPI scopes.	Found capacitor C–407 short-circuited. Replaced.
Polarity of signals reversed; signal appeared below lines of sweep on range scope, and as area free from signals on PPI scope.	V–432 (6AC7) defective. Replaced.
Indication of false signal on all positions of antenna.	Trouble due to failure of V–204 (RKR73) in unit 921–C from lack of sufficient bias. Lack of bias due to leakage of C–214. Replaced V–204 and C–214 from ship's spares.
No sweep on either range or PPI scopes.	Found coaxial lines from radar trans. conv. 921–C improperly connected to jacks J–403 and J–406. Interchanged these leads thus restoring sweeps to the range and PPI scopes.
Multiple trace on range scope jagged lines on PPI using range marker pips. Blurred picture on operate.	Motor generator running too slow. Speeded up motor of motor generator to run at 3450 RPM.
Short sweep.	Resistor R–428 changed value.
Sweeps short on both ranges.	Readjusting C–464 and C–465 lengthened sweeps on both ranges.
Blurred and unstable indications on both scopes on 48,000-yard range scale only; 16,000-yard range normal.	Small adjustment of R–504 voltage control.
Very short sweep length on "A" scope and PPI scope.	Sweeps very erratic. Caused by high voltage rectifier tube V–422 improperly seated in socket.

Receiver-Indicator—Continued

NATURE OF DIFFICULTY	TROUBLE FOUND AND REMEDY
Heavy radial lines on PPI scope tube and unstable trace on "A" scope tube, V–405.	Deflection coil rings and brushes were dirty. Cleaned deflection coil rings and brushes of PPI assembly to eliminate interference on PPI's scope tube, V–412 and instability of trace on "A" scope tube, V–405.
Horizontal sweep on tubes V–405 and V–412 satisfactory when set was energized but would gradually disappear.	Replaced capacitor C–448, from ship's spares thus restoring sweep to tubes V–405 and V–412. This condenser was found to have a resistance of 70 ohms, warm.
Lack of horizontal-sweep synchronization in both indicator screens.	Traced to defective sweep-gate tube, V–402.
"A" scope sweep and PPI sweep very short.	Raised B voltage to 300 by means of R–504 which restored normal operation.
The trace on both scopes was jittery.	Cured jittery trace by replacing capacitor C–476 in receiver strip.
There were two calibrating pips every 2,000 yards instead of the usual single pip.	This trouble was due to the crystal pip generator oscillations not being damped out. The double calibration pip was eliminated by adjusting the damping circuit capacitor (C–422) of the calibration pip crystal.
No calibration markers.	Markers lost in plate circuit of amplifier V–407. No screen voltage present, caused by shorted screen bypass capacitor, C–476. Replacement made.
Erratic pattern visible on "A" scope when switch S–403 in CALIBRATE position. Horizontal and vertical sweep out of adjustment on "A" scope.	Faults corrected by adjustment of R–504, R–446, R–444, and R–445.
No calibration pips on either scopes, only slight humps on V–405, "A" scope.	Adjusted C–422.
No calibration pips observed on range scope V–405 when switch in "CALIBRATE" position.	Multivibrator tube V–408 was found to be defective and upon replacement calibration pips were observed on range scope.
No calibration "pips" when switch S–403 placed in CALIBRATE position.	Lack of calibration pips due to faulty calibration oscillator tube V–496. Replaced with new tube from ship's spares.
Too many calibration pips on both ranges. The base line moves up as the range step moves to the right.	Reset the sweep-gate control C–463, to give the proper number of calibration pips.
Range pips piled up on left hand side of "A" scope.	V–404 (6SN7GT) was defective; replaced tube from ship's spares.
Calibration traces on the range scope bunched at the ends.	Readjusted R–504 and R–478 to limit the range trace.
Incorrect number of pips in CALIBRATE position.	Adjusted C–463 to give sufficient calibration pips.
Range pips would suddenly fall off without turning range gate potentiometer.	Potentiometer R–406 had poor contact between collector ring and movable arm. This caused range pips to fall off.
Calibration pips half usual size on "A" scope (V–405) No calibration pips on PPI.	Replaced PPI limiter tube (V–410). This tube was found to be shorted which caused the trouble.
Nonlinear sweep for calibrating pips on both scopes, the first 2 or 3 pips being crowded together.	Adjusted resistors R–497, R–478, R–556, and R–504 to center sweep on tube V–412, and give best linearity of sweep on both scopes.

Receiver-Indicator—Continued

NATURE OF DIFFICULTY	TROUBLE FOUND AND REMEDY
No range step.	Found R–417 open. Replaced.
Range indicator in receiver 920A stuck.	Removed entire mechanical range indicating mechanism in receiver. Failure caused by loose locknut on dial shaft. Reassembled and recalibrated.
The range step had a decided tendency to be unstable.	Replaced C–425 and the unstable condition was corrected.
Dial on range indicator would not turn.	Bushing had worked loose jamming dial mechanism. Readjusted and tightened dial mechanism so that it would operate properly. Also adjusted training control mechanism to prevent slipping. Left the equipment operating very statisfactorily.
Range step traveled across "A" scope when range dial was set on certain positions.	Adjusted contact arm on range potentiometer R–406 so that it made contact with resistance strip at all times.
Range control R–406 friction drive was erratic in operation, slipping intermittently as control turned.	Range control was dismantled and friction drive washers were found rusted solid to the shaft. Washers were freed and very small amount of oil applied so that compression spring acted on friction clutch. Unit reassembled and adjusted.
When range dial had been working range step would not go to end of sweep in spite of the fact that range dial would continue on to the low end of the scale.	Range dial was adjusted on shaft of potentiometer R–406 so that step would run down to the end of the sweep.
When range dial was turned, the range step jumped position on the "A" scope rather than ran smoothly from right to left.	Removed, cleaned, and replaced R–406.
It was found that when the step control was turned to approximately 44,000 long scale, the sweep line would jump by one-quarter inch up or down depending on direction of turning.	This defect was overcome by changing tube V–401 and adjusting the voltage through R–504.
No range step; extra calibration pip on both ranges; range set controls ineffective.	R–415 resistor replaced.
Range dial clutch slipping. Range dial could not be adjusted to low end of scale.	Tightened range dial clutch that had come loose from use.
Impossible to range on the lower limits of the scale.	Range dial had slipped on shaft of R–406 causing slider on taper resistance to reach end of travel before dial reached its lower ranging limits. As a result range step ceased to go below a certain ranging limit. Removing back cover on R–406 and making new adjustments corrected this trouble.
Range gate not taking effect at high range end of dial.	Increased sweep gate by varying C–463 so that sweep gate and range gate coincided.
Range step "drifting"—not following smoothly the adjust of the range potentiometer.	Cleaned wiper arm of range potentiometer.
Only about ¼-inch step on range marker on "A" scope.	Value of R–414 was 2,400 ohms instead of 2,500 ohms.
Jittery range step on "A" scope tube.	Replaced defective A scope tube V–405 from ship's spares.
Drive mechanism in range dial found slipping.	Tightened pressure plate on ball bearing drive thus eliminating in slipping range dial.

Receiver-Indicator—Continued

NATURE OF DIFFICULTY	TROUBLE FOUND AND REMEDY
Range dial slipping.	Range dial friction washer reversed and tension increased.
Equipment was operating but all targets received when the antenna was trained manually were 180° out, in bearing. When automatic training was used, the position of the targets continually shifted around the center of the scope.	The 180°-bearing shift was due to incorrect antenna synchro control leads and reversed connections to the antenna drive motor armature. The antenna covering was removed and the polarity of the antenna motor armature was checked with a d-c voltmeter and found to be reversed. This condition, plus the incorrect connection of the synchro phase had been causing the antenna to oscillate rather than to spin around in a clockwise direction. The necessary changes were made in these connections and correct bearings as well as a stationary pattern was received on the indicating scopes.
Almost continuous training error during automatic training.	Corrected polarity of voltage to field of motor B–101 and tuned control rectifier, eliminating training error.
Flashing inside the indicator equipment and on the PPI scope tube. The class "A" scope was showing quite normal signals but the PPI tube was not. There were very faint indications of signal present and the sweep was not normal.	After some checking we found an open resistor R–486 resulting in no plate voltage on the 6SN7 tube V–410.
V–434, output tube in receiver strip, not lighted. New tube tried in socket, found not to operate.	Receiver strip removed and broken filament lead on ground side of V–434 socket repaired. Strip replaced and equipment found to be satisfactory.
Equipment inoperative after being turned on for about 10 or 15 minutes. Tuning "eye" ceased to function after this period.	Belden cable (coaxial) carrying intermediate frequency amplifier, inner conductor had sharp bend. Crystal and oscillator tube cavities out of tune. Expansion of inner conductor of coaxial cable with heat was excessive. The defective cable was shortened, using the portion of cable that was still satisfactory. The crystal and McNally tube cavities were tuned after the unit had heated up. They then remained in tune during operation of the equipment. It was advised that the equipment be warmed up approximately 15 minutes before operation, as the crystal cavity temperature caused the crystal current to vary gently as the temperature was changed by opening of the cabinet.
Found shaft on potentiometer R–506, frozen to bearing surface.	Removed bushing and shaft of potentiometer R–506, from panel. Smoothed and polished surfaces, freeing shaft.
Lack of signal sensitivity.	Lack of signal sensitivity due to low voltage on 300-volt bus. Increased voltage by means of adjustment of R–504.
Erratic local oscillator tuning.	R–506 potentiometer (local oscillation control), opened up in one section. Replaced.
Tuning eye V–423 would not open when the local oscillator was out of tune.	The reducing of the coupling between the crystal cavity and the local oscillator did not help the tuning eye. It was therefore necessary to shunt resistor R–411 (1.0-meg., ½-watt) with a 1.0-meg., ½-watt to reduce the resistance of R–411 to 0.5 megohm. This allowed the tuning eye to open slightly when the receiver was out of tune.

Receiver-Indicator—Continued

NATURE OF DIFFICULTY	TROUBLE FOUND AND REMEDY
Low output from i-f strip.	Found P & J–403 defective. Replaced same, resulting in full gain from i-f strip.
Potentiometer R–506 shaft hard to turn.	Oiled potentiometer shaft with light machine oil so shaft would turn freely.
The fuse 401 burned out. After replacing the fuse, the plates of both 5U4G tubes (V–417 and V–418) got red hot and both tubes burned out.	The voltage on the 5U4G tubes was measured and found to be 400 volts instead of 300 volts.
Constant training error noted, as indicated by training error indicator I–407.	Meshed antenna and synchro gears more closely. Also shimmed up antenna motor B–101 which was binding. These adjustments cleared up the trouble.
L. O. control was grinding in the bearing.	Remedied by dismantling, cleaning and oiling and re-assembling.
Clutch on L. O. tuning shaft R–506 slipping.	Decreased spacing between two disks on L. O. tuning shaft which cured slippage.
Found receiver blowing fuses and V–417 and 418 plates getting red hot.	McNally tube had shorted the 300-volt line to ground. Replaced tube.
No screen grid voltage on 6V6 (V–434).	Replaced shorted capacitor C–475 A, B, C with new one from tender spares.
Could not control voltage by adjusting R–504. Voltage stayed at 330 volts.	Changed V–416 (6SJ7) which corrected trouble in voltage regulator.
Multiple traces on range scope.	Check for defective scope tube, defective V–409, interference from motors B–201 and/or B–202—install filter (Field Change 40), check C–238, and C–239. Possible interference from B–401—clean brushes and commutator, install filter (Field Change 8). Check C–457 for short (if necessary to replace, use 1,000 volt capacitor if available). Check V–410 and/or V–411.
Return trace present on range scope.	Check V–405, V–403, and V–412 (possibility of cathode to ground short).
Enlarged presentation on the range scope.	Check V–405, R–442, R–443, R–447, R–448, R–522, R–523, R–524, and R–525. If only 1 or 2 resistors have changed value, replace the individual resistors, if the majority of the resistors are high or low in value, the entire panel, E–406, should be replaced; (If no new, impregnated panel is available, the old panel should be thoroughly dried and all defective resistors replaced.)
Jittery presentation on the range scope.	Check for defective V–405, C–415, and erratic 300 volt regulated supply. Possible interference from motors B–201 and B–202. Check C–238, C–239, and V–410/V–411.
"Dogears" on top of echo pips on range scope.	Accurately check values of R–584 and C–494. Replace resistor and/or capacitor using values as for Field Change 16.
No range step on range scope.	Check for defective V–401, R–406, R–415, C–402, C–458, and S–401. If S–401 is inoperative or defective, check for and repair any broken leads, tighten switch rigidly to panel and replace if necessary. Check for grounds in the ranging circuit.

Receiver-Indicator—Continued

NATURE OF DIFFICULTY	TROUBLE FOUND AND REMEDY
Shallow range step on range scope.	Check R–414 for correct value, replace if value has changed.
Double range step on range scope.	Check for defective V–401.
Improper focus on PPI.	Check for defective V–412, R–497 if accompanied by loss of trace on range scope, one end of R–526 possibly shorting to leads in nearby cable—check and increase clearance if necessary.
PPI doesn't center properly.	Check for dirty or defective R–478 and possibly open deflection coil L–405.
No trace on PPI.	Check for defective scope V–412. Brushes for PPI deflection coil, L–406, dirty or stuck in holder—clean, repair or replace.
Short trace on PPI.	Check for defective V–412, R–556, and R–492.
Blank segments—spokes—PPI scope.	Check for defective V–412. Brushes and slip rings for L–406 dirty or rough—If slip rings are but slightly rough, smooth with crocus cloth, otherwise replace; Replace any badly worn or damaged brushes; clean with Carbon-tet, Lubri-plate or similar substance. Cathode lead connected to wrong side of filament winding in transformer, T–401.
No range dot on PPI.	Check for defective V–410.
Both scopes—excessive intensity.	Negative 150-volt line shorted to ground—Locate and remove (the arm of L. O. tuning potentiometer, R–507, will sometimes become grounded when in its extreme counterclockwise position).
Both scopes—no trace (either on CALIBRATE or OPERATE).	Check for defective V–402, V–409, V–422, R–425 (SF), R–541 (SF–1), or R–542 (SF–1). Check capacitors C–405, C–406, C–407, or C–463.
Both scopes—no trace (on OPERATE only).	No trigger pulse from transmitter.
Both scopes—short trace (both ranges).	C–463 out of adjustment. Check for defective C–405 or C–463.
Both scopes—short trace (short range only).	Check for defective C–409 or C–464.
Both scopes—short trace (long range only).	Check for defective C–410, C–465, or C–468.
Both scopes—jittery image. (On CALIBRATE and OPERATE).	Check for defective V–405 or V–412. Erratic 300 volt supply. Defective C–405 or C–406. Switch S–403 not operating properly—Check for and repair any broken leads—replace switch if necessary.
Both scopes—jittery image (On CALIBRATE only).	Check for defective V–407 or V–408.
Both scopes—fading signals.	Check for defective V–405 or V–412. Check for defective V–210 in transmitter, retune cavity. Heater for L. O. cavity in transmitter operating improperly—Adjust thermostat, replace heater if defective. Fluctuating 400-cycle voltage.
Both scopes—no echoes—some "Grass".	TR coupling loop broken or improperly positioned.
Both scopes—excessive "Grass".	Sockets for V–405 or V–412, or for any pre amp and i-f tubes—dirty or defective—Clean, adjust contacts or replace. Defective rectifier crystal Y–201.

Receiver-Indicator—Continued

NATURE OF DIFFICULTY	TROUBLE FOUND AND REMEDY
Both scopes—no calibration markers.	Check adjustment of C–422. Check for defective Y–401, V–406, C–423, C–476, L–401, or L–402.
Both scopes—jittery calibration markers.	300 volt supply too high—Reduce to proper value. Resistors R–421 and/or R–422 outside of tolerance—replace.
300-volt supply low.	Check for defective R–504, V–417, V–418, V–414, V–415, and V–436.
300-volt supply erratic.	One or more tubes, V–414, V–415, V–436, V–416, or V–421, defective—Replace. Check for defective R–504.
No trigger pulse from transmitter.	Transmitter not operating. "Trigger Pulse" and "Signal" coaxial cables from transmitter reversed—Correct.
No current reading (echo box ringing appears on range scope).	Defective M–1401—Repair or replace. M–1401, external shunt not removed upon installation of radar—Remove shunt. Rectifier crystal Y–101 defective—Replace crystal. Coaxial cable to meter M–1401 open or shorted—Correct fault or replace. Check for defective C–1401.
Suggestions for overcoming radio interference.	Bond all units, cables, coax, etc., to as good a ground as is available. Insert a choke (20–25 turns No. 14 wire, ½-inch–¾-inch diameter, airwound) in series with plate lead directly at tubes V–601 and V–602 in control rectifier. Connect 0.1μf or smaller capacitor from terminal No. 5 on control rectifier to ground.

Motor Generator

Regulation erratic.	Potentiometer R–301 defective—Replace; if potentiometer has only a small defective spot, set "No-load" voltage at 113 or 117 without regulation. Relay K–301 defective—Replace.
Doesn't remain running.	Loose terminal lug in magnetic controller.
Doesn't stop when STOP button is pressed.	START-STOP switch S–405 is sticking or defective. Repair or replace.
Excessive vibration.	Shaft turning inside of inner ball bearing race—Tighten race or replace bearing. Loose coupling—Tighten or replace.
Speed governor points badly burned.	On 902-c M–G, points breaking too much current—Make Field Change 20. Capacitor C–802, loose or defective—Reconnect or replace.
400-cycle voltage doesn't "come on".	START-STOP switch S–405, sticky or defective—Repair or replace. Open starting coil in magnetic controller—Replace. Loose pin in starting coil plunger—Tighten. Motor-generator running too slowly—Adjust speed governor. Relays K–301 or K–802, defective—Replace.

Motor Generator—Continued

NATURE OF DIFFICULTY	TROUBLE FOUND AND REMEDY
400-cycle voltage can't be set at 115 volts.	Motor Generator running too slowly—Adjust speed governor. R–801 out of adjustment or defective—Adjust or replace. R–301 in voltage regulator dirty or defective—Clean or replace. Battery E–301 in voltage regulator defective—Replace. Capacitor C–301 in voltage regulator defective—Replace. Check for defective tubes V–301, V–302, V–303.
Fluctuating a-c supply voltage on M–1001—reached 150 volts. Motor generator speed excessively high.	(1) Speed regulator brushes broke off. (2) Capacitor on speed regulator thrown off or shorted. (3) Speed regulator contacts pitted and stuck together. Replaced speed regulator and made Field Change 20.
Voltage on M–1001 very low—85 volts. The voltage control had been adjusted until all of R–801 was cut out of the field circuit. The speed of motor-generator seemed to be too low.	Speed regulator contacts froze together. Replaced speed regulator. WARNING: *Do not adjust R–801 on the generator until you have checked speed of motor with tachometer to be 3,450 rpm.*
Voltage on M–1001 very low—30 volts. Speed was correct, and R–801 was all the way out of generator field circuit.	Found commutator badly burned, brushes wore off. Light cut taken on commutator and replaced brushes. NOTE: The brushes on generator, exciter, motor, and speed regulator should be inspected weekly. They should fit snugly but free in movement. The commutator should be a chocolate brown in color.
Ship's radio receiver picking up commutator noise from radar motor-generator.	Placed two 0.1 μf 600 v. capacitors across motor of motor-generator set (terminals 12 and 13 in junction box "A"). Grounded center of these two capacitors. The noise level of the motor generator was reduced about 3 to 4 db on the pilothouse receiver. This receiver is equipped with AVC and during "standby" periods the volume is quite high. During periods of reception no noise was observed with the radar equipment in operation.
No voltage to equipment.	Exciter voltage brushes failed to make contact on commutator—springs loose.
Fluctuating a-c voltage output.	Found contacts of speed regulator wit.. too wide separation. Reduced separation to 0.008 inch.
Very low voltage output from generator, 20 volts.	Found and corrected loose connection to resistor R–801. Found generator brushes making poor contact. Corrected same. Found that the lugs on back of the generator panel connecting to terminals 3 and 4 had turned so that they also were making contact to terminals 5 and 6, respectively, thus paralleling the armature and control field windings. Corrected this.
A-c voltage was 112 volts.	Raised a-c voltage to 115 volts by means of R–301.
The motor operated normally, but there was intermittent generator output, because of a poor contact by the slider of R–801.	Cleaned contact surface of R–801 and made secure connection of slider to resistor.

Motor Generator—Continued

NATURE OF DIFFICULTY	TROUBLE FOUND AND REMEDY
The commutator of the generator exciter was badly worn.	Cleaned and sanded commutator of generator exciter.
Speed of 400 cycle alternator quite high. Output voltage of the alternator was above 200 volts.	The transformer in the voltage regulator (UX–7016D transformer) was burned up. Armature of alternator driving motor was grounded. Speed regulator on alternator was inoperative; "C" battery in voltage control unit was dead. Tore down the d-c motor of the alternator unit and removed the ground by baking the armature. Found one loose connection in the field which may have caused the lack of speed control. The speed control disk was burned on the back (commutator) side and was refaced in a lathe. The burned contact points on the speed control disk were refaced and adjusted to hold 3,450 rpm.
No a-c voltage.	Generator brush held away from contact with slip ring at intermittent points of revolution. Sanded flat sides of brush to enable it to slide in brush holder.
Line voltage increased to about 170 volts.	Remedied by replacing speed governor brushes on motor generator.
Speed on motor generator was erratic after replacement of the speed regulator.	Found wrong type speed regulator used. (NOTE: There are two speed regulators in stock by mistake. One is rated at 3,450 rpm, and a second one is rated at 1,800 rpm. The only identification between the two is the specification on the shipping carton containing the regulator.)
Excessive sparking of exciter generator brushes.	Shifted brushes to proper place in relation to flux in exciter field. This stopped sparking and increased voltage output from exciter. It was then necessary to lower the no load voltage by cutting in more resistance at R–801.
Speed too slow.	Brushes stuck in holder and were too short. NOTE: *All brushes* in the motor generator should be taken out of holders once a week, checked for burning and free movement in holders.
Magnetic starter cut motor generator in on line without starting sequence taking place on contact fingers.	Copper contact pigtails were laced together so as to hold all contacts in line so that in starting all three fingers made contact simultaneously. The pigtails were separated allowing normal operation.
Armature and brush rigging hot to ground with magnetic switch in off position.	This condition was corrected by reversing 115 volt d-c lines at magnetic starter. L1 was made positive and L2 negative.
Speed regulator contacts bad, also slip ring very dirty.	Cleaned and adjusted speed regulator in 904A.
Motor generator running fast. Three lamps in series with control field of generator to hold voltage down.	Motor generator speed was checked and it was found to be running at about 3,750 rpm. Brushes on the motor were moved from neutral position. These were reset to their proper positions and the motor now ran at its normal speed. Lamps were removed from control field.

Motor Generator—Continued

NATURE OF DIFFICULTY	TROUBLE FOUND AND REMEDY
Motor generator was running too fast.	Found brush on speed regulator had worn down to point where the circuit was opened.
Magnetic controller would not hold in and keep the motor running after closing manually.	It was found that the wire leading from the holding coil to terminal No. 3 was open at the lug. This wire was cut back and resoldered. The controller worked normally afterward.
Interference from SF motor-generator set present in ship-high frequency radio receiver.	Found both connections to capacitor C–801 very loose. After tightening these connections the interference disappeared.
Burned spot on one of the generator sliprings causing excessive brush wear.	Generator removed from ship and sliprings turned down.
The motor was running at 5,000 rpm, the speed regulator having no control.	The connections from A1 and L2 in the magnetic controller were reversed at the connection to the motor. These were corrected and the motor operated properly.
Operator reported that equipment would run for about 20 minutes and then cut out for about 3 minutes.	Ran motor generator for 2-hour test but could not get equipment to cut out. Tapped relay K–301 lightly and relay K–801 in MG set opened up. Put in new relay K–301 (Edison type). Test ran equipment for 1½ hours and equipment seemed to work fine.
Navy Field Change 20 had been made, but motor speed measured 3,350 rpm, instead of recommended 3,450 rpm.	Adjusted contacts, E–801 to secure recommended motor speed of 3,500 rpm.
Sparking at brushes of motor B–801.	Freed one of brushes on motor B–801 which was stuck in brush holder and had been causing sparking. The brush opposite the one sparking will usually be found at fault, i. e., not enough tension, not properly seated, or stuck in holder.
Poor speed regulation.	It has been found desirable to clean out all collected carbon dust from speed regulator on motor generator weekly to insure proper speed regulation.
Louis-Allis motor-generator was hunting, however, it was set at 3,450 rpm.	The speed was increased to 3,500 rpm. This eliminated the hunting and did not affect the equipment operation. This speed has been approved for all CLL MG sets.
Relay K–801 would not pull in at all times.	Spring tension was found to be too great, therefore the tension was decreased until it pulled in readily.
Field voltage was set too high.	Adjusted field voltage to 117 volts by increasing resistance of R–801.
The motor generator speed was 3,300 rpm, and the voltage was 90 volts.	The speed was checked with a tachometer and brought up to 3,450 rpm by adjustment of R–802.
Excessive arcing on main arcing contact of magnetic controller.	Removed arcing contact, cleaned and adjusted.
No a-c voltage on terminals 1 and 8 after closing of K–801.	Contacts of relay K–801 were cleaned and adjusted thus restoring a-c voltage across terminals 1 and 8 after closing of K–801.

Voltage Regulator

NATURE OF DIFFICULTY	TROUBLE FOUND AND REMEDY
R–301 had no control of the firing of V–303 causing very high a-c voltage at all times as indicated by M–1001.	Battery E–301 was found to be shorted to the outer metal container. Replaced.
A-c line voltage would vary when PPI training motor was turned on and voltage would vary 10 to 15 volts.	Voltage leak from battery E–301 to case caused voltage to vary. Wrapped battery in fish paper which cured fluctuating voltage.
Battery shorting to ground through case.	Wrapped case with friction tape.
Voltage regulator would not function properly.	Trouble was found to be that the internal jumper wire between terminal 6 on side of generator to terminal 12 on K–801 relay was missing. Thus there was no control field on generator and no plate voltage on V–303 in voltage regulator.
A-c line voltage measured 112 volts, below recommended a-c line voltage of 115 volts.	Adjusted potentiometer, R–301, to secure recommended line voltage of 115 volts a-c.
Low magnetron current.	The voltage regulator 904A was not functioning. V–303 (C1B) was not firing. Adjusted R–301 to the proper line voltage as indicated by M–1001.
Unable to bring a-c voltage to rated value. Adjustment of R–301 gave a voltage up to 100 v., then a jump to 150 v. with no inbetween voltage.	V–301, a 6SN7, was found defective.
Equipment would automatically turn off after several hours of operation.	K–301 in voltage regulator 904A intermittent in operation which accounted for trouble. Replaced K–301 in regulator 904A.
When adjustments were made for increasing voltage, voltage would lower.	Reversed terminal connections 5 and 6 on the MG, normal control was obtained. A checkup showed that the polarity of the exciter voltage had changed and interchanging these control field connections restored control conditions to normal.
No regulation obtainable.	No connection between terminals 6 and 12, in motor-generator—Install connecting wire. "No-Load" voltage too high—Adjust R–801 in motor-generator to give a "No-Load" voltage of 115 without regulation. Battery E–301 defective—Replace. Check V–301, V–302, or V–303.